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Carotid-Body Tumors ... *John J. Conley*

Anticoagulant Therapy in Otitic Thrombophlebitis ... *Zivar Berkman*

Coccidioidomycosis with Endolaryngeal Involvement ... *Hartzikan, Stuart Chaplin, F. Yost, and John H. Gladney*

Primary Grafting in Reconstruction and Mastoidectomy Cavities ... *Ben T. Withers*

Rhinoplastic Sequelae Discussed by Patients ... *Irving B. Goldman*

Frontal Sinus Drainage ... *G. Edward Tyrrell*

Cricoarytenoid Arthritis or Laryngeal Paralysis? ... *William H. Saunders*

End-Organ Deafness ... *Kinsey M. Simonton*

A Clinical Method for Testing the Bone-Conduction Audiometer ... *Arthur E. Roach and Raymond Carhart*

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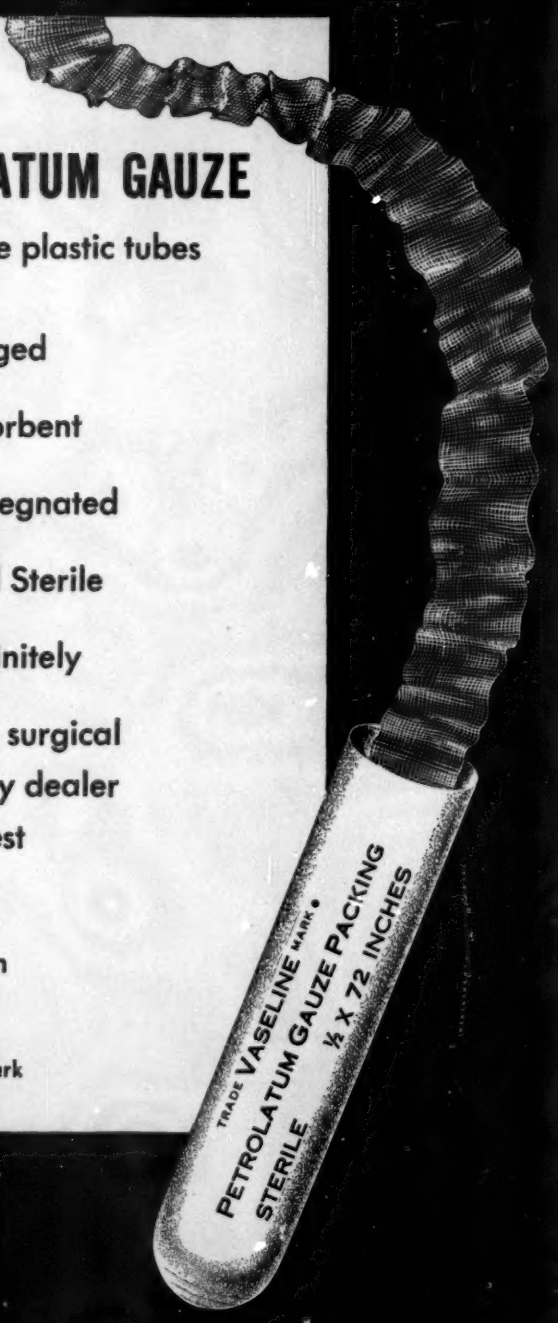

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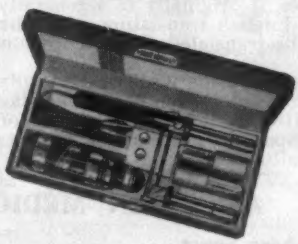

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A.M.A. Archives OF OTOLARYNGOLOGY

Carotid-Body Tumors

JOHN J. CONLEY, M.D., New York

Of all the neurogenous tumors occurring in the neck, the carotid-body tumor is the commonest and one of the most interesting. In the past five years considerable attention has been directed toward the diagnosis and treatment of this tumor. Disagreement and confusion have existed concerning the biology of this tumor and its management. Pathologists have disagreed about its malignant potentialities, and surgeons have disagreed as to whether the tumor should be extirpated or a *noli-me-tangere* attitude should be followed. Incontestable proof has been recently furnished that the carotid-body tumor manifests not only regional metastasis but can also spread throughout the body in a small percentage of cases. It is estimated that approximately 15% of the cases of carotid-body tumor are malignant, thus adding considerable gravity to their proper management.[4] The *noli-me-tangere* attitude was originally a consequence of the prohibitive operative mortality of 40%-55% reported in the past, when attempts were made to totally extirpate this tumor.* Newer concepts and techniques of treatment have eliminated the tragic aspects of these problems and added reasonable security to the surgical management.

Accepted for publication Jan. 5, 1956.

From the Head and Neck Department of the Pack Medical Group and the Surgical Service, St. Vincent's Hospital.

* References 1 to 3.

The greatest single deterrent to the proper management of carotid-body tumors in the past has been the prohibitive mortality associated with the ligation or excision of the common and internal carotid arteries. The direct result of such ligation or excision is the reduced blood flow to the homolateral side of the brain.

The elective ligation of the common and internal carotid arteries in neurosurgical procedures primarily for the treatment of intracranial aneurysm or arterial venous fistula has a mortality of 10%-20%. This † is in dramatic contrast to the 50% reported for the elective or compulsory ligation of the common and internal carotid arteries by oncologists. The principle of gradual occlusion of the carotid artery was presented with the hope of overcoming the complications associated with sudden occlusion. The idea was stimulating theoretically, but practically it has not been fruitful. It had the disadvantages of being an indeterminate procedure, since it was not possible to evaluate the required gradualness of the compression, except on the patient's clinical response to it. It is reasonable to believe that certain persons who possess the compensatory facility will adjust to gradual carotid-artery pressure over a period of days, weeks, or months. It is also likely that some persons do not have and cannot develop adequate collateral circulation in the brain to accommodate gradual compression. It is in this latter group where either sudden hemiplegia or sudden death has occurred. Often, tumors have caused

† References 5 and 6.

occlusion of the common and internal carotid arteries by their growth and development. This gradual biological compression in slow-growing tumors may be extended over a period of several years and in almost all instances occurs without complications. Moore [7] has recently published the markedly improved figures of 30% cerebral complications and 10% mortality in carotid-artery ligations associated with tumor therapy. He attributed this improvement to the maintenance of a normal blood pressure and prevention of shock.

An understanding of the vascular principles applied to the carotid arteries and the brain by means of intra-arterial pressures in the carotid arteries before and after ligation is important. It was found that after ligation of the common carotid artery the intra-arterial pressure in the distal segment fell by approximately 50%.[8] In some it fell more and in some, less. The pressure in the internal carotid artery after ligation of the common carotid artery could be higher than that in the ipsilateral external carotid artery if there was an efficient circle of Willis in the brain. The pressure in the external carotid artery was higher than that in the internal carotid artery on the ipsilateral side if the circle of Willis was deficient and if the anastomotic branches of the external carotid artery throughout the face were abundant. These data have highlighted the importance of not only the relative drops in intra-arterial pressures in the common carotid artery after occlusion but also emphasize the importance of an efficient and adequate circle of Willis in the procurement and distribution of blood from the contralateral side. From these data one can conclude that if there is only a 20% or 30% drop in the intra-arterial pressure in the distal segment of the ligated common carotid artery the procedure can be carried out without great danger of cerebral complications. If, on the other hand, there is a drop of 70% or 80% in the intra-arterial pressure in the distal segment of the ligated common carotid artery, one must believe that the dangers of cerebral complications are greatly increased and that definite preparations should be made to reconstitute the vascular channel. One can further conclude that if there is an average drop of approximately 50% in the intra-arterial pressure reading in the distal segment of the ligated common carotid artery, and if upon further investigation the drop in the internal carotid artery appears to be less than that in the external carotid artery upon individual ligation, one can be sure the blood will flow from the contralateral side through the circle of Willis and thence into the ipsilateral internal carotid artery and out into the external carotid artery. This is considered a more favorable situation than that associated with an inefficient circle of Willis where the blood must flow from the ipsilateral external carotid artery into the ipsilateral internal carotid artery to reach the brain on that side.

DIAGNOSIS

An accurate preoperative diagnosis of carotid-body tumor is not always possible. However, the combination of a group of facts contained in the clinical history and preoperative examination may be strongly suggestive. The pertinent feature of this tumor as far as the history is concerned is the patient's description of a painless, slow-growing tumor mass in the side of the neck which has usually been present for months or years and which is causing him no difficulty. Only rarely does the carotid-body tumor cause a sense of pain, pressure, and syncope. Physical examination reveals a firm mass of varying size in the region of the carotid bifurcation. This mass moves with arterial pulsations but is not compressible. It is fixed to the carotid vessel and semifixed to the deeper structures of the neck. It can be moved horizontally with ease but has very little vertical movement.

One of the important steps in the preoperative study is the elimination of other pathological processes which simulate this

condition. Metastatic cancer is the commonest and most important disease to be excluded in the differential diagnosis. In metastatic cancer in the neck the examiner can usually find a primary malignant tumor in the oral cavity or some other place in the head-and-neck system. In addition to this, aspiration biopsy of metastatic cancer is approximately 90% accurate. Branchiogenic cysts may simulate carotid-body tumor, and their diagnosis is usually established by obtaining the characteristic fluid upon aspiration. Metastatic cancer of the thyroid may simulate carotid-body tumor, but one can usually feel the primary nodularity of the thyroid gland and one might expect an assist from aspiration biopsy, although the value of this technique in this instance is not reliable.

Aspiration biopsy of carotid-body tumor in the hands of a person well accommodated to the interpretation of this technique may be suggestive but is never conclusive. Frozen-section examination is helpful but is rarely indicated or necessary. Once the tumor has been exposed surgically and evaluated, the diagnosis is apparent. A decision is made at this time to either remove the tumor or perform a formal biopsy and permit the tumor to remain in position. The appearance of the tumor microscopically upon frozen section has little relationship to the clinical course of the disease and should not be a determinate factor as to the type of treatment. Indeed, at the present time there is no satisfactory method of determining microscopically in all instances which carotid-body tumors are malignant and will metastasize and which are benign. The tumors are composed of epithelioid cells containing some variation in the size and shape of the nuclei and surrounded by vascular stroma. Mitotic figures are very rare. In spite of the apparent microscopic benignancy, 15% of the carotid-body tumors behave in a malignant fashion by either locally invading the surrounding tissues, metastasizing to the neck, or manifesting generalized metastasis. Local and systemic metastasis has been disputed in the past, but the report of recent instances has eliminated this doubt.‡

TREATMENT

In the past the treatment of carotid-body tumor has been one of the most confusing and serious aspects of the disease. The surgical extirpation of the tumor, along with the common and the internal carotid artery, carried a prohibitive mortality. The passive attitude of simply watching the tumors and not administering any therapy, which was a direct outgrowth of the high operative mortality, was unsatisfactory in light of the recent studies of the malignant behavior of this tumor. Over the past five years a considerable amount of attention has been devoted in the hope that this unsatisfactory dilemma might be resolved. In 1940, Gordon-Taylor [11] suggested that by careful dissection these tumors could be removed in many instances by confining the dissection to a so-called "white line." The dissection in the serosal plane of the great vessels to maintain their continuity was again proposed by Morfit,[9] in a splendid paper on carotid-body tumors meriting individual review. The rationale of the serosal dissection of this tumor is supported by the fact that the carotid body, as well as carotid-body tumor, develops in the serosa and does not penetrate into the muscular or intimal layers of the carotid-artery wall. Turnbull and Morfit have both reported cases of malignant carotid-body tumor where the media of the vessel had not been invaded by the tumor, thus establishing at least the possibility of maintaining the carotid vessels inviolate.

The treatment revolves itself essentially around two techniques. The primary technique should be concerned with the extirpation of the carotid-body tumor alone, without injury to the great vessels. The second technique concerns itself with the excision of the carotid-body tumor and common and internal carotid arteries, when that is found necessary, and maintaining the continuity of the vascular channel.

‡ References 9 and 10.

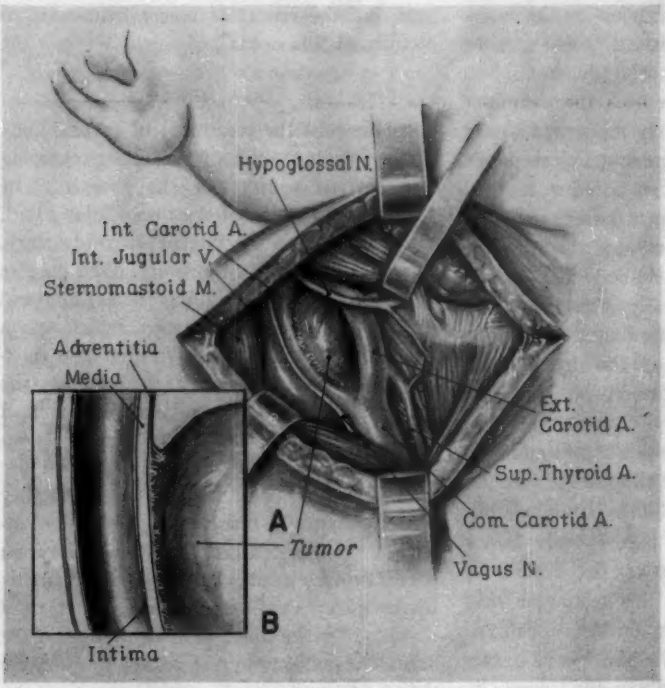

Fig. 1.—*A*, small carotid-body tumor; *B*, relationship of carotid-body tumor with media.

It is a fact that the majority of the small carotid-body tumors that are unoperated on and unirradiated can be removed without occlusion of the common and internal carotid arteries. The tumor is intimately adherent to the adventitia of the carotid artery, and the dissection is carried out in a careful and painstaking manner. As the tumor is separated from the carotid vessel there is a moderate amount of bleeding. Visibility in the field is maintained by applying firm packs over the tumor and spot suction along the line of dissection. The limits of the tumor should be well defined surgically, and the proximal and distal portions of the common, internal, and external carotid arteries should be dissected free, so that hemostasis may be applied at these points if there is an inadvertent tear in the artery while dissecting the tumor. If an inadvertent tear occurs it should be repaired immediately by direct approximation with 0000 Atraumatic arterial nonabsorbable surgical (silk) sutures. Evaluation of this specific treatment for carotid-body tumor must await the passing of years, because this dissection is carried out microscopically close to the tumor itself and, indeed, there is the possibility that some of these tumors might recur. It, nevertheless, remains the treatment of choice.

In case of the very large complicated tumor which has almost completely encompassed the carotid artery, which is locally invasive and has more than likely been operated upon previously, it is frequently impossible to remove this type of tumor without serious injury to or actual resection of the carotid artery. Indeed, in many of these instances, the internal carotid artery has been gradually compressed by the growth of the tumor and is often physiologically occluded. This situation can be determined preoperatively by angiography. When this information is available to the surgeon preoperatively he may plan his resection to include the common and internal carotid arteries without fear of central nervous system complications.

When preoperative angiogram of the carotid artery shows a full lumen in the internal carotid artery and it is technically impossible to remove the tumor without injury to these vessels, appropriate steps must be taken to maintain the blood supply to the brain. Intra-arterial pressure readings should be taken in the distal segment of the internal carotid artery before and after ligation, to establish the relative drop in intra-arterial pressure. If the drop in the distal segment is minimal (10%-20%) one might have some justification for removing the carotid-body tumor with the associated carotid arteries, with a minimal operative mortality and neurological sequelae. On the other hand, if there is a severe drop in intra-arterial pressure in the distal segments of the internal carotid artery upon ligation of the common carotid artery, one is obligated to reestablish the continuity of this vascular channel. This is, of course, best accomplished by the substitution of a new vessel. Indeed, of all the tumors encountered in the neck which may afflict this important blood vessel, the carotid-body tumor is perhaps the one best suited for vascular grafting when this procedure becomes an absolute necessity. The technique is carried out usually in a clean natural and healthy tissue bed completely receptive for a graft. Under these circumstances one can hardly see any justification for not substituting a vascular graft in all instances where it is necessary to resect the common and internal carotid arteries, including those where ligation causes only a minimal drop in the intra-arterial pressure in the distal segment of the vessel.

A carotid-artery homograft offers the greatest facility for replacement. If a homograft is not available then one should use an autogenous vein graft. A superficial femoral vein graft is readily available and completely satisfactory. If, for some reason, it cannot be used, the great saphenous may be substituted, but it is frequently too small in diameter. Before attempting to procure a vein from the leg the ipsilateral internal jugular and external jugular veins should be examined and considered as possible grafts. Unfortunately, often the major portion of the internal jugular vein is involved in the tumor mass and only the inferior segment is available for use. Often the external jugular vein is not of adequate size. The grafts are carefully sutured into the void with two continuous Atraumatic arterial nonabsorbable sutures. Heparin solution is used locally in the graft and on the suture line during the technique but is not used postoperatively.

Fig. 2.—Internal and external carotid arteries compressed by tumor as seen in angiogram.

The technique of ipsilateral anastomosis of the distal cut segment of the external carotid artery to the distal segment of the internal carotid artery is usually not necessary or advisable in the treatment of carotid-body tumors. When vascular surgery is necessary in the treatment of this tumor, total substitution of a new vessel is the method of choice. Ipsilateral anastomosis may prove to be lifesaving when the lateral neck tissue bed is necrotic and devitalized and infected from an oral fistula and carotid-artery hemorrhage has necessitated compulsory ligation. It would appear that the direction of the blood flow in this ipsilateral anastomosis is not the deciding factor. When one appreciates how rapidly fatal a hemorrhage from the distal segments of the external or internal carotid artery can be, the value of having this arterial blood pass through the cerebral system is apparent. Another important factor may be the prevention of ascending thrombus formation in the distal segment of the internal carotid artery, which, without anastomosis, becomes an end-artery. When ipsilateral anastomosis is employed, the resection of the superior cervical ganglion may permanently increase the blood supply to the brain on the ipsilateral side. Resection of a superior cervical ganglion is not indicated in free vessel grafting.

COMPLICATIONS

When it is possible to extirpate the entire carotid-body tumor and permit the great vessels and nerve to remain intact, complications should indeed be at a minimum. When it is necessary to carry out minor repairs on the vessel as the result of small tears, complications should be at a minimum. When it has been necessary to resect a large portion of the common and internal carotid arteries and substitution blood-vessel surgery has been carried out, complications should be minimal. However, one must be prepared for air embolus or thrombus formation about the suture line of the vessel with embolic phenomenon or obstruction to the vessel. Air embolus should not occur if the technique is carried out properly, with special attention to the evacuation of all air from the graft. Thrombosis of this vessel, if the technique is carried out properly, when the nutritional bed is healthy, would be most unusual in view of the fact that the intra-arterial pressure and blood flow are so high. The same situation would pertain even in the absence of anticoagulants. If hemiplegia should develop after the operation, reexploration of the wound or angiography is indicated.

When the carotid-body tumor is large and has completely enmeshed the major cranial nerve pathways in this area it is frequently necessary to resect nerves along with the tumor. The nerves most frequently involved are the vagus and hypoglossal. The spinal accessory and the sympathetic chain are rarely involved. Resection of the vagus nerve at this level of the neck causes a paralysis of the palate and vocal cords with anesthesia of the pharynx. There is associated pylorospasm and esophagospasm. The clinical course is complicated by frequent episodes of regurgitation and aspiration of food into the trachea. An elective low tracheostomy and tube feeding circumvent these situations until the patient has mastered the technique of swallowing without aspiration. Resection of the hypoglossal nerve causes a paralysis of the tongue on the affected side. There is subsequent atrophy of the tongue on that side, with some thickening of speech and interference in deglutition. However, after a period of several months the patient usually manages to accommodate his speech and eating habits to this glossal weakness. If only short segments of these nerves have been resected an effort should be made at direct anastomosis of the cut portions. If this is impossible, consideration should be given to nerve grafting, using appropriate branches from the sensory portion of the cervical plexus. Ordinarily, the spinal accessory nerves and sympathetic chain are not involved by the tumor unless there is direct invasion or the tumor manifests malignant qualities which necessitate a radical neck dissection. Resection of the spinal accessory

nerve causes a dropping of the shoulder on that side, with a weakness about the shoulder girdle and on elevation of the arm. Resection of the sympathetic chain causes an increase of blood supply to the brain on the ipsilateral side and a Horner's syndrome.

SUMMARY

The modern concepts of the biology and treatment of carotid-body tumors are presented.

The difficulties of attempting to correlate the clinical cause of the disease with the microscopic picture are related.

Differential diagnosis is outlined.

The relationships and hazards pertaining to the carotid arteries are emphasized. The treatment of choice is the resection of the carotid-body tumor without injury to the carotid vessels. When the carotid vessels are removed blood-vessel anastomosis is indicated.

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Anticoagulant Therapy in Otitic Thrombophlebitis

Report of Six Cases

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Five mastoidectomies and forty-two radical mastoidectomies were performed in thirty months during the 1951-1953 period, after which ten cases had complications. Of the latter six were thrombophlebitis and the remaining four cerebral abscess cases.

The treatment of otitic thrombophlebitis, of which the incidence among the intracranial complications is second only to otitic meningitis, has begun to show many characteristic features with the advent of antibiotics and, particularly, of anticoagulants. As is known, the removal of the primary focus followed by thrombectomy, rare cases excepted, has become a rule. With the exception of a suppurated thrombus, ligation of the internal jugular vein has not been generally accepted. In the cases treated by my co-workers and me we deemed it suitable to perform jugular ligation according to the course of the disease.

In our opinion, jugular ligation is not, as a rule, an intervention to be performed after thrombectomy. If the patient shows no improvement, however, it can then be performed. In case pus is observed when the lateral sinus is exposed, jugular ligation must be performed immediately. Furthermore, in the days following thrombectomy, jugular ligation must be performed if the distal end of the lateral sinus discharges any pus, accompanied by intermittent high fever. If no fever is found, the mere existence of pus does not justify performing jugular ligation. The following cases have confirmed our belief.

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REPORT OF CASES

CASE 1.—A 21-year-old soldier complained of pain in his left ear, headache on the same side, and running ear. He was hospitalized on Nov. 20, 1951. According to his report, two months before his admission to the hospital both his ears began to run after they had been boxed by somebody. He was first examined at Sarikamiş Military Hospital. Although he was given penicillin injections, his temperature began to rise in a week, accompanied by a chilly sensation and dizziness. These soon disappeared, and he was discharged from the hospital. On his arrival at the village, headache and dizziness returned. Then, he was referred to the Gülhane Post-Graduate Hospital. Examination revealed a cicatrice on the right drumhead. In the left ear a pulsating purulent discharge and a small central perforation on the drumhead were observed. The apex and posterior borders of the left mastoid were sensitive to pressure. He could hear whispers on the left within a foot and a half. After a diagnosis of chronic mastoiditis, we performed a mastoidectomy three days following his admission to the hospital. Pathological findings of the operation were as follows:

External table of the mastoid bone bled profusely. Although the superficial cellular structure showed little inflammation, the lateral sinus appeared to have a pathological dehiscence with granulation tissue. The apex and sinofacial cells were inflamed. Puncture into the sinus produced no blood. Thrombectomy was performed. A small curette was inserted through the incision, and all clots were removed. Then, the proximal end of the lateral sinus was induced to bleed, though the distal end failed to bleed. The bleeding in question was stopped by packing. The mastoid cavity

was left open in order that the course of disease could be observed.

In the days following the operation the temperature remained high and a considerable amount of pus was observed issuing from the floor of the tympanum. Penicillin injections were given to the patient. No chilly sensation accompanied by a rise in temperature was seen, though antibiotic treatment did not reduce the temperature. As we did not ligate the internal jugular vein, we considered the possibility of the development of a thrombus. We therefore administered an anticoagulant, ethyl biscoumacetate (Tromexan),* a week after the operation. So long as anticoagulant treatment continued the temperature remained below 37 C (98.6 F). Anticoagulant treatment was discontinued 10 days later. Within three days the temperature began to rise again above 98.6 F. With the temperature rising after the cessation of anticoagulant treatment, and with pus issuing from the floor of the tympanum, we had to interfere and perform a second operation, viz., radical mastoidectomy. After the operation, the patient complained of attacks similar to angina pectoris. In the neck, he had a pain along the jugular vein. Blood culture was negative. The second day of the operation, palpation of the neck revealed a painful and string-like jugular vein. The patient complained of infrequent chilly sensations and restlessness. This restlessness was so intense that the patient had hysterical fits and cried for hours. Liquid drawn by lumbar puncture showed no pathological evidence, while fundus revealed nothing but slight engorgement of the veins. Thereupon the patient was continuously given ethyl biscoumacetate tablets—three tablets the first day, two the second, one the third, and one each day for the rest of the treatment. The patient was released within two months.

Comment.—As it may be gathered from the report of the patient, the disease started as a result of an acute otitis media followed by trauma. We had previously observed chilly sensations and high fever following some traumatic middle-ear infections. Such fever and chilly sensations are much different from those of common acute middle-ear infections. A sudden invasion of the exposed and defenseless middle ear by microorganisms causes the disease to follow a serious course. This must be attributed to hemorrhagic mastoiditis, viz., osteophlebitis pyemia. In this case penicillin shots, by lowering the temperature, disguised a complicated feverish middle-ear inflammation, transforming it into a simple middle-ear inflammation, feverless and with a hidden complication. We did not in this case perform jugular ligation.

Case 2.—A 22-year-old man, complaining of a headache on the left, nausea, dizziness, a running left ear, and high fever, was admitted to the hospital at night on May 2, 1952. According to his report, his left ear had discharged for eight years and had been occasionally painful. Three days before his admittance into the ENT ward, there appeared severe headache on the left and pain on the left mastoid region, accompanied by intermittent feverish and chilly sensations and vomiting.

The records showed that he had been admitted and discharged a week earlier. Then otoscopy had revealed a wide central perforation of the drumhead, slight suppurative discharge that filled the floor of the tympanum, and granulation tissue.

Since the patient had no other complaints, topical treatment was prescribed for him. But contrary to my advice, the resident, anticipating a speedy recovery, administered penicillin injections. The aural discharge having stopped within three to four days, the patient was discharged. A week later, however, the same patient, with very severe complications, came back.

His general condition was very disturbing. He was greatly agitated, sweated profusely, and kept turning from one side to the other in bed. He complained of chilly sensations and throbbing pain on the left of his neck. Temperature was 39.2 C (102.5 F); pulse rate was 116, full and regular.

Otoscopy revealed an external auditory canal filled with pus having an offensive odor. There was total perforation in the drumhead. The floor of the tympanum was fully covered with granulation tissue, through which pus issued forth as it was swept out. The mastoid region was sensitive to pressure. Griesinger's sign was positive, and the course of the left jugular vein sensitive to pressure. The sternocleidomastoid muscle of the affected side being hard and painful owing to contraction, the patient kept his head inclined to the left, unable to move it. The left ear was normal. Kernig's sign was negative. Cerebrospinal liquid showed nothing abnormal. With a diagnosis of otitic thrombophlebitis an operation was carried out on May 10, 1952. Pathological findings of the operation were as follows:

Bone necrosis, pus retention in the cells near the sinus. In the antrum there was necrosis instead of pus. Radical mastoidectomy was first performed.

*Ethyl biscoumacetate is a preparation made by Geigy Pharmaceuticals, Division of Geigy Chemical Corporation.

The internal plates were removed. Sinus bony plate was normal. When the tegmen antri was removed the dura mater appeared normal. On the other hand, sinodural cells were filled with pus. When the bony plate of the sinus was entirely removed, with the exception of the lower portion of the sinus that extends toward the jugular bulb, the sinus wall, though smooth, was found to have lost its bluish color. While the lower portion of the sinus was covered with granulation tissue, the bony plate of that portion showed no pathological changes. Destruction was more apparent on the apex of the mastoid. At first, a needle was inserted through the dura mater into the middle fossa, to see if there was any brain abscess. The result was negative. Then a puncture was made in the sinus, but no blood could be obtained from it. Thereupon thrombectomy was performed. The sinus was filled with a red thrombus. While bleeding could be induced on the proximal end of the sinus, the same could not be induced on the distal end. During this period the patient's condition was aggravated, pulsation was weak, and spasmodic convulsions were observed. Since the operation had almost been completed, no further intervention was made.

In the days following the operation the patient's fever continued. Penicillin and sulfonamides were administered to the patient. Three days after the operation a large amount of pus came out of the distal end of the sinus, which could not be induced to bleed. When the neck was pressed along the jugular vein, the mastoid cavity was filled with pus from the distal end of the sinus. As the temperature of the patient continued to remain high and his condition in general did not improve, a jugular ligation was performed. During the ligation pus accumulation was observed around the big vessels. The fascia covering the internal jugular vein, carotid artery, and vagus was much thickened, due to inflammation. The jugular vein had become yellowish. Although the jugular vein was followed down to find the normal color, no normal portion of it was found. The jugular vein was thrombosed all along the neck. Therefore it was ligated at a point situated as low as possible. The severed upper part of the vein was sutured onto the skin, with a fine drain tube being inserted into the vein. Following the ligation, the patient's general condition began to improve. Medical treatment consisted of penicillin, streptomycin sulfate, and the sulfonamides.

Chilly sensations reappeared on May 15, 1952. Herpes was seen on the lips. The patient expectorated bloody sputum. Upon this an x-ray examination was made on May 24, 1952.

The result of the x-ray examination: Right lung field was obscured by homogeneous pleural opacity, which rose to the level of the free end of the third rib and which projected upward in a radiating form. On the same side there was a slight partial pneumothorax and a slight shrinking in the same hemithorax (Fig. 1). In the left lung field there were the follwoing: (1) a cyst-like shadow the size of a large hazel nut, superimposed on the free end of the third rib; (2) another the size of a small tangerine, between the free ends of the fourth and fifth ribs, partially disappearing under the shadow of the heart and with a fluid level in it; (3) still another, the size of a walnut, behind the free ends of the fifth and sixth ribs (Fig. 1).

The internist, as a result of his examination, spoke of a slight lung embolism. Penicillin dosage was increased. The patient was feeling rather

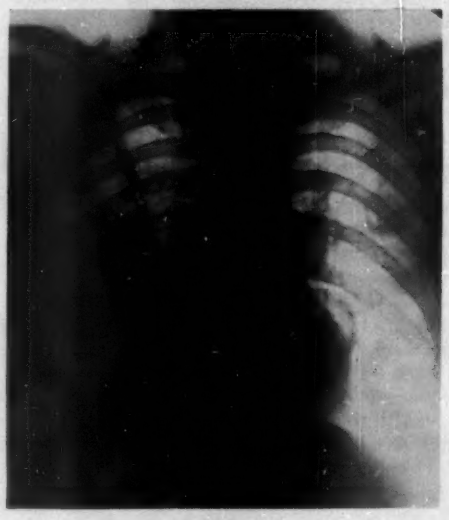


Fig. 1 (Case 2)

distressed. Suspecting a collection in the thorax, we made a puncture therein. The result was negative, though the patient felt much relieved. This relief also suggested the possibility of a pneumothorax. With the partial release of the air, the puncture gave relief to the patient, who kept expectorating bloody and purulent sputum. It was evident that antibiotics had no effect. Thereupon, an anticoagulant (ethyl biscoumacetate) was administered, 20 days after the last operation. The patient's general condition began to improve, the temperature falling below 98.6 F. In a week the temperature and pulse rate became normal, the bloody sputum stopped, and the patient began to feel very well. Upon this, anticoagulant administration was stopped after an eight-day period. But, a week after the cessation of anticoagulant

administration, the temperature suddenly began to rise again. The penicillin shots were reestablished. Since no response was observed, ethyl biscoumacetate was added to the penicillin shots. Thereafter the temperature fell. After one week's anticoagulant administration the patient's temperature did not rise again, and the patient recovered.

Comment.—It is very probable that in this case pathogenesis of the thrombophlebitis was a direct extension from the floor of the tympanum. The fact that the tympanal floor was granular and that pus had long accumulated there in profusion led us to consider this probability. On the other hand, while the bony plate was intact, the lower end of the lateral sinus was covered by granulation tissue, which extended under the external bony canal of the ear toward the jugular bulb.

This case also has shown that one must be cautious in applying conservative treatment to heavily purulent discharges in a chronic case. Even if a random penicillin administration might stop dischargings, the disease itself is not cured, even though complications are concealed. This case has further shown what we can call the marvelous effect of anticoagulants. To the best of our knowledge, the middle portion of the thrombus has long been accepted as infected. The antibiotic administered naturally will not affect the source of infection. On the other hand, if one does not remove the infected thrombus, one should not expect much from the use of antibiotics. It is probable, though a hypothesis has not yet been proved, that anticoagulants, while reducing the tendency to thrombosis, dissolve it and expose the concealed organisms to the effect of antibiotics.

By an x-ray check on June 5, 1952, we followed up what had been previously observed. This x-ray check showed the following:

On the right there was a pneumothorax, partial and with a fluid level. On the left, superimposed on the free end of the fifth rib, was a cystic shadow (Fig. 2).

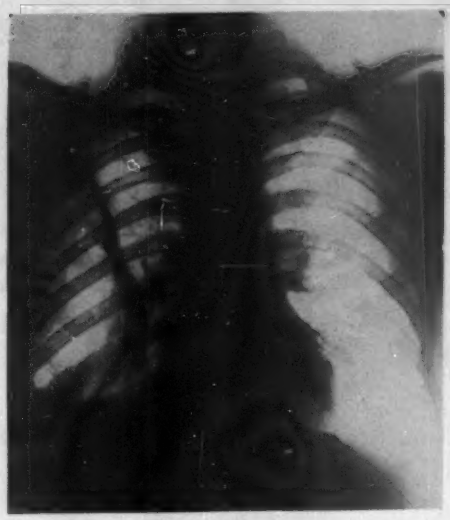


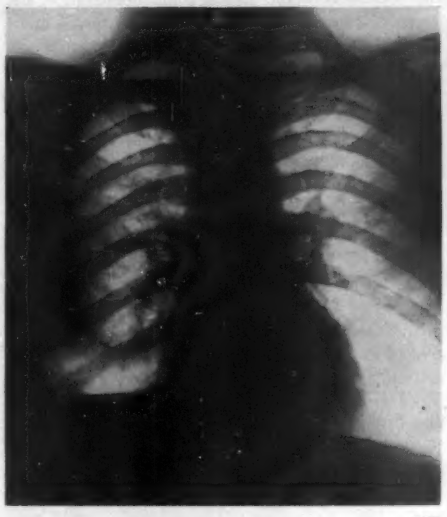
Fig. 2 (Case 2)

A film on July 9, 1952, showed the following:

The base of the right lung was obscured by homogeneous opacity laterally rising to the level of the free end of the sixth rib. The left lung was normal (Fig. 3).

Another film on Aug. 20, 1952, showed an increase in the shadows of both hili, with a fibrous residue shadow between the free

Fig. 3 (Case 2)



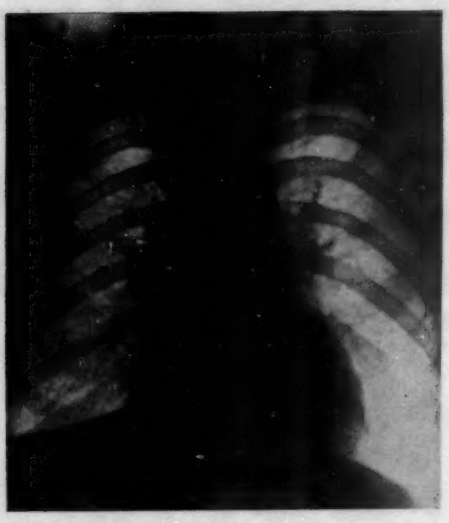


Fig. 4 (Case 2)

ends of the second and third ribs on the right. Pathological changes brought about in the lung field as a result of the complication of the disease finally disappeared, leaving a very slight trace (Fig. 4).

Case 3.—A 22-year-old man was admitted to our clinic on Jan. 19, 1953, with an ache in his right ear. According to his statement, four years previously his right ear started to run for no apparent reason. He then felt no pain. This running now and then stopped, though sometimes it continued for a month. Of late the ache increased and became constant. In otoscopic examination, the posterior-superior wall of the right external auditory canal was seen bulging in the lumen of the canal, so the middle ear could not be studied. On the left drumhead calcareous plaques were seen. Mastoid was not sensitive to pressure. On account of constant aches and the bulging of the posterior and superior walls, intervention was decided upon. Within two days of the patient's admittance radical mastoidectomy was performed. Pathological findings were as follows:

When the periosteum was elevated, a fistula was found at the junction of the posterior-superior walls of the external auditory canal. The bony wall of the sinus was destroyed and the sinus wall covered by granulation tissue. Mastoid was necrosed at several places. Tympanum was filled with polyps. Since a few punctures in the sinus did not produce blood, the possibility of obstruction was considered. Nevertheless, because no high fever or chilly sensation was observed, thrombectomy was not performed. It was decided that thrombectomy depended on the future course of the disease. Postauricular incision was sutured. Treatment consisted of penicillin injection and three days after operation, of ethyl biscoumacetate. In spite of this treatment the patient's temperature, along with a chilly sensation, rose to 39 C (102.2 F). The fever, however, had not entirely disappeared in the days following the operation. Blood smear was examined for plasmodium, with a negative result. Nothing could be discovered to account for the fever. From the 14th day following the operation the patient's temperature continued to be high and intermittent, accompanied by headaches. Thereupon, in spite of the anticoagulant treatment, the wound was reopened for a check-up and, if necessary, for a thrombectomy. This second intervention revealed an abscess between the dura mater, which was exposed during the first intervention, and the upper part of the membranous canal, which had been sutured against the dura. This abscess accounted for the fever, but to be on the safe side a puncture was again made in the sinus. Three punctures—made at the top, in the middle, and at the bottom—filled the syringe with blood. The area with the abscess was cleared; upper part of the membranous canal was removed. The wound was sutured again.

The temperature returned to normal. Anticoagulant administration was stopped three days after the second intervention and penicillin injections four days after. The patient was discharged on Feb. 23, 1953, and was told to come back as an outpatient for dressing.

Comment.—This case is noteworthy in that it brings to mind the possibility of a misleading fever caused by suppuration between a plastic flap and the dura mater exposed during the operation. Furthermore, in this case we had the opportunity to observe the recanalization of a thrombosed sinus following anticoagulant administration. Although this case is unique, noncritical thrombosis cases, we are inclined to think, can be treated under anticoagulant control without recourse to thrombectomy.

Case 4.—A 35-year-old man was urgently referred to our clinic on April 18, 1953, complaining of high fever, headache, and a running right ear. According to his report, radical mastoidectomy was performed on him at Trabzon Nümune Hospital on Feb. 24, 1953. Because of facial paralysis caused by operation he was sent to Ankara for physical treatment. Meanwhile, after-care for the wound was undertaken by the same hospital. As soon as discharging stopped during dressing, rising of temperature and headache were sometimes observed. Finally, two days before he was admitted to our

hospital his temperature rose considerably, accompanied by a severe headache and loss of consciousness. Then he was referred to our service. We found that radical mastoidectomy had been performed on the right ear, which was filled with granulation tissue. Pulsating discharge was seen in the tympanic area. Stiffness of the neck was obvious. Lumbar puncture produced increased pressure. Cerebrospinal fluid was turbid. Pandy's and Nonne's reactions were 4+ positive. Cell counting was 30 per cubic millimeter. With a diagnosis of meningitis the patient was operated on by the chief resident. On reoperating on the cavity, the antrum was found filled with granulation tissue. Thereupon, the tegmina tympani and antri, which appeared necrosed, were removed. The bony wall of the sinus was removed only in a limited area, and it was found smooth, with no granulation tissue. The appearance of the dura mater was normal. Mastoid bone showed excessive bleeding. The wound was left unsutured. No improvement was observed in the days immediately following the operation. In addition to penicillin and oxytetracycline (Terramycin) injections, hypertonic dextrose solution was administered intravenously. Neck stiffness continued. Once in 24 hours the patient's temperature, accompanied by a chilly sensation, rose to 40 C (104 F). The patient's general condition seemed very grave. In cerebral-fluid examination cell counting was 30, Pandy and Nonne markedly positive, and albumin 0.80 gm. On the other hand, 30.0 units of penicillin was given intrathecally. Because intermittent high temperature accompanied by a chilly sensation suggested the possibility of thrombophlebitis, a puncture was made into the partially exposed sinus. No blood, however, could be obtained. Then we had to intervene for the third time. When the bony plate of the sinus was entirely removed, the sinus wall was found smooth, with no granulation tissue. But instead of the normal bluish color, the sinus appeared yellowish. Several punctures made at different points on the sinus produced no blood. Then we began to remove the bony plate till we found the normal color of the sinus. A big sequestrum was found when the sinodural region was being removed. Here the dura mater did not have a normal appearance. Intracranial puncture made in this part for any possible brain abscess was negative. The transverse portion of the lateral sinus was exposed as far back as possible, but no normal sinus wall could be encountered. Bone removing was discontinued at this point and an incision made on the sinus. The sinus wall was found much thickened, but the lumen had become so narrowed that a tympanal curette could just be inserted in it. The distal end of the sinus could not be induced to bleed. Bleeding produced on the proximal end was very little. A small rubber tube was inserted in the distal end of the sinus, and the wound was left unsutured.

Following the operation the patient's temperature gradually responded to oxytetracycline and ethyl biscoumacetate administration. The patient's temperature, except for the high temperature which began four days after the third intervention and lasted only four days, returned to normal.

During the above-mentioned four days, when the temperature rose again, we thought the sulfonamides would be beneficial, so we added azosulfamide (Prontosil) to the intravenously administered oxytetracycline, besides the oral administration of the sulfonamides.

In a lumbar puncture made five days after the third intervention Pandy was positive and cell counting 80. Blood culture prepared during the high fever proved negative.

The above-mentioned treatment brought the patient's temperature down to normal, and neck stiffness and headaches disappeared. After a period of physical treatment the patient was discharged, with recovery. The patient did not benefit much from physical treatment for facial paralysis. While lagophthalmus considerably diminished, the brows remained motionless and a look of classical facial paralysis lingered.

Comment.—During the period when the patient was under observation, and even 36 hours after our third intervention, the patient's general condition did not look very hopeful at all. It is our firm belief that this satisfactory result was due to the removal of the sequestrum and to ethyl miscoumacetate administration.

Case 5.—A 12-year-old boy had high fever, chilly sensations, and headaches, so he consulted an internist and was admitted on April 22, 1953, to the internal disease ward, Medical Faculty, Ankara, for checks to determine if he had typhoid fever. During the five days he remained in the said ward, his temperature stood at 102.2 F or more. Because of a painful hard swelling on the left side and upper area of the neck, the patient was referred to our service for examination. We found that the patient had total perforation of the drumhead and pulsating discharge. On the left side of the neck was a swelling which extended from the attachment of the sternocleidomastoid muscle down to the middle of the said muscle. A diagnosis of thrombophlebitis was made by us. The operation performed produced the following pathological findings:

Bony plate of the sinus was completely destroyed. Sinus wall covered by granulation tissue. A punc-

ture produced no blood. Thrombectomy was performed. While the proximal end could be induced to bleed, the distal end could not. A rubber tube was inserted into the distal end. A day later, when the wound was being examined, a considerable amount of pus was seen issuing from the distal end, and a pressure on the neck produced a continuous flow of much pus. The pus was both drained and sucked out by an aspirator every day. The patient was given ethyl biscoumacetate and oxytetracycline. During the following two days the maximum temperature was 38 C (100.4 F). Then it gradually returned to normal, chilly sensations disappeared, and the patient, now fully recovered, was discharged.

Comment. — Notwithstanding the excess amount of pus that issued from the lower part of the sinus in this case, we felt no need to ligate the internal jugular vein in view of the improvement in the patient's general condition.

CASE 6.—A 20-year-old soldier, suffering from headaches, earaches, and a running ear, was transferred from the internal diseases ward to our service. According to his report, both ears had kept running since childhood, though the left ear more so than the right one. When he had been to his village on a furlough, the running in his ears diminished but headache started. On returning to his unit, he had a high fever, with undiminished headache. This was followed by vomitings. Thereupon he was admitted to the internal diseases ward. He looked exhausted and partially deranged. When he said he had a running ear, he was referred to our service for an examination. Otoscopy revealed a foul-smelling secretion in the left external auditory canal as well as a cicatricial constriction in the isthmus. A cotton applicator could barely pass through that constriction. Discharge was pulsative. The right ear, too, had a small amount of foul-smelling discharge. There was total and peripheric perforation in the drumhead. Stiffness of the neck was obvious. Temperature was 102.5 F. Lumbar puncture showed an opalescent fluid. The presence of constriction and much discharge in the left ear compelled us to intervene on that side. Pathological findings of the radical mastoidectomy on the left were as follows:

A cell the size of a chick-pea was found close to the dura mater, filled with pus and on a level with the tegmen antri. The bony wall of the sinus was removed. Sinus was found normal. Puncture was made and blood was withdrawn. When the tegmen antri was removed, the dura was found covered with granulation tissue. A puncture made in the direction of the temporal lobe was negative. Plastic intervention was made, but the retroauricular incision was left unsutured. After this operation the patient's headache and neck stiffness disappeared and vomitings ceased. An intermittent high fever, however, developed. Lumbar puncture showed a clear fluid. Pandy was positive-negative; cell count 50. Azosulfamide was given the patient orally and in an 0.83% solution intrathecally. The subsequent liquid examinaiton showed a clear liquid. Cell count was 4 and Pandy negative. The intermittent high temperature fell to 98.6-99.1 F four days after the operation. The frequency of pulse, however, was markedly low (60 to 65 per minute). Blood culture made two days after the operation, when the temperature was high and intermittent, was positive for Streptococcus hemolyticus. This suggested to us the presence of thrombophlebitis in the right ear, and we accordingly intervened a week after the first operation. Pathological findings of the second operation were as follows:

Bony wall of the sinus was necrosed and sinus wall covered with granulation tissue. Puncture produced no blood. Thrombectomy was performed. The proximal end of the sinus could be induced to bleed, but the distal end could not. Normal sinus wall could not be found at the distal end. A small rubber tube was inserted in it for drainage. Later examinations showed no pus issuing from the distal end. We immediately began to administer an anticoagulant: heparin. In addition azosulfamide was injected both intramuscularly and intravenously. In spite of this, the patient's temperature remained high. Six days after the operation an abscess formation became evident in the right iliac. Four days later an incision was made into the abscess. We attributed this abscess to quinine injection made before the second operation during the high fever. A considerable amount of pus flowed out of the abscess. In the following days the patient's temperature returned to normal, and he was discharged, with recovery.

Comment.—The characteristic feature of this case was that the patient had bilateral chronic otitis media, which might have simultaneously caused intracranial complications. Our preoperative diagnosis was meningitis. Following the operation on the left ear, meningeal signs disappeared, while, on the other hand, thrombophlebitic symptoms became visible.

In the face of a complication arising from bilateral chronic otitis media, it is difficult to determine which side requires intervention. However, notwithstanding a pathological finding that may account for the complication on the side determined, we believe

that it is necessary to intervene without delay if the opposite side caused some other intracranial complication. In the above case, we intervened on both sides in time.

SUMMARY

In five thrombophlebitis cases out of the six mentioned above, we only performed a thrombectomy, while in the remaining case we performed a thrombectomy and ligated the internal jugular vein. We believe it is necessary to perform a thrombectomy in each thrombophlebitis case. However, we did not perform a thrombectomy in one case. This was due to the satisfactory general condition of the patient and to our confidence in anticoagulants.

In the two cases out of five in which the distal end could not be induced to bleed after thrombectomy, pus issued from the said side. Of the two cases, one having followed a pyemic course, we ligated the jugular vein. In the other case, however, the general condition of the patient being satisfactory, we did not ligate the jugular vein.

Coccidioidomycosis with Endolaryngeal Involvement

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With the advent of antibiotic agents in recent years, certain of the previously regarded major infectious diseases have diminished in relative clinical importance. Moreover, diseases that were rare or unrecognized previously are receiving more attention. Of the latter group, coccidioidomycosis is representative of this newly directed attention to diseases of mycotic origin.

This disease was first described, in 1892, by Wernicke.[1] He described the lesions as "granulation tissue tumors" and classified the positive parasite as a protozoan. The disease exists clinically in three principal forms,[2] viz., (1) the primary pulmonary type, (2) the primary cutaneous type, and (3) the progressive granulomatous type. The last two types are sometimes described clinically as the progressive granulocutaneous type. It is generalized and carries a high mortality. Dickson first suggested the general term coccidioidomycosis to include the various clinical forms of the disease.[3]

PATHOGENESIS

It was not until 1937 that Dickson [3] associated the Coccidioides immitis organism with the "valley fever" of the San Joaquin Valley. Valley fever is a relatively mild pulmonary disease, with an almost negligible mortality. It is represented anatomically by essentially nongranulomatous inflammation of the lung, of either focal or diffuse character, accompanied by bronchial and mediastinal adenitis and, in many cases, erythema nodosum. Primary pulmonary coccidioidomycosis heals completely without residual pulmonary lesions; the granulomatous lesions arise by reinfection. The reinfection may be brought about by bronchial ulceration and aspiration of an infectious exudate or by vascular dissemination of organisms throughout the body.

Although the disease can be contracted through the skin after slight trauma, by far the commonest portal of entry is the respiratory tract. The dry hyphae of the mold contain chlamydospores. It is the inhalation of these chlamydospores, which represent one form in the life cycle of Coccidioides immitis, that is responsible for contracting of the disease in the human. Although the disease is usually considered to be contagious, the dry chlamydospores that are seen in abundance in the arid Southwest or in laboratory preparations are probably necessary for its propagation.

The chlamydospores reproduce in the body by the transformation of the cytoplasmic contents into a sac-like mass of spores. This process is termed endosporulation, and never in the course of coccidioidomycosis infection does budding occur. This is in contrast to other mycotic diseases, notable among which are blastomycosis and actinomycosis, with which coccidioidomycosis is often clinically confused.

The commonest sites of the lesions of coccidioidomycosis resulting from dissemination

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are listed by Forbus [4] to be as follows: (1) lungs, (2) lymph nodes, (3) spleen, (4) skin, (5) liver, (6) kidneys, (7) bones, (8) meninges, (9) adrenals, (10) myocardium.

Forbus lists the distribution of lesions in 50 autopsies, and he mentions the trachea and larynx as being the sites of either a gross or microscopic lesion, but no detail is given in these latter sites of affliction. Mumma [5] reports a case of coccidioidomycosis of the epiglottis in which the phonating action of the larynx was not involved.

THERAPY

No specific therapy has proved itself to be of avail in the treatment of coccidioidomycosis. The efficacy of stilbamidine in the treatment of related fungus diseases, however, is under investigation and no superior medicinal agent is at present reported.

REPORT OF CASE

A 34-year-old Negro man was admitted to the Hines Veterans Administration Hospital on Jan. 29, 1954. His presenting complaints were a moderately productive cough of three months' duration and a hoarseness and dysphagia of one month's duration. It was these latter complaints of dysphagia and of hoarseness that caused him to seek medical advice from his family physician four days prior to hospital admission. A chest x-ray taken by his family physician demonstrated multiple small pulmonary opacities of calcific density in the right hilar region. He was referred to the Hines VAH for laryngoscopy because of a suspicion of laryngeal tuberculosis.

Fig. 2.—Granulomatous cutaneous lesion of dorsum of nose prior to therapy.

There has been no history of hemoptysis or shortness of breath. The dysphagia he described as mild but admitted a weight loss of 15 to 20 lb. in the previous three months before admission.

The patient served in the Army from 1942 to 1945 and was encamped in the California desert approximately 12 months of that time. He noted a sore on the dorsum of his nose approximately one year prior to admission, which he contends represents an area where he picked a blackhead. He was addicted to diacetylmorphine until six months prior

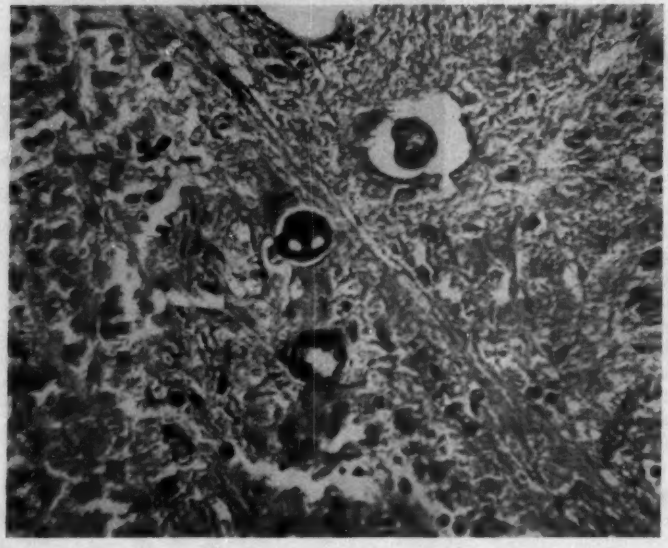

Fig. 1. — Double-contoured endospore filled spherules of Coccidioides immitis in tissue from trachea. A granulomatous inflammatory reaction is in surrounding tissue.

Fig. 3.—Cutaneous lesion of left index finger.

to admission. He had gonorrheal urethritis in 1950 and had a bubo on the right groin incised in 1947. There was no known history of contact with active pulmonary tuberculosis.

On examination there was seen a thinly built Negro man who appeared older than his stated age of 34 years. Respirations were somewhat labored and were accompanied by laryngeal stridor on both inspiration and expiration. Temperature was 99 F, respiration rate 18, pulse rate 80, and blood pressure 92/70. A bronzed circumscribed proliferative lesion was seen on the dorsum of the nose and measured approximately 1.5 by 2 cm. in greatest diameters. A punched-out, dirty grayish, ulcerative lesion measuring 0.5 cm. in its greatest diameter was seen on the distal phalanx of the left index finger. Indirect laryngoscopy revealed an extensive fungating granuloma involving the vestibule and endolarynx; the epiglottis was thickened and contained an ulcerative lesion of the laryngeal surface. There was considerable edema of both arytenoids and aryepiglottic folds, with distortion of the normal outline. A grayish-white ulcerative granuloma extended into both ventricles. The rima glottidis was slit-like and was almost completely fixed by the tumor mass. There was pooling of saliva in both pyriform sinuses. Auscultation of the chest revealed a few course rhonchi heard posteriorly over the upper left chest. A healed scar was seen in the right inguinal region. Small shotty nontender anterior cervical lymph nodes were palpated on the right side.

On admission hemogram revealed a WBC of 7000 and a RBC of 4,890,000. Hemoglobin content was 14.5 gm/100 cc. Serology was negative. Initial urinalysis showed a faint trace of albumin. A sputum culture revealed alpha-hemolytic streptococci and Neisseria catarrhalis organisms. The sputum was negative for acid-fast bacilli. One week following admission, the white blood cell count was essentially unchanged, however, a differential showed 87% neutrophiles, 8% lymphocytes, and 5% eosinophiles. On the ninth hospital day tracheostomy was necessary because of increasing laryngeal stridor and a biopsy specimen of granulomatous tissue was taken from within the trachea at the level of the third tracheal cartilage. The histological sections of this tissue were reported as demonstrating Coccidioides immitis. Eighteen days after admission the serum sodium was 138 mEq/liter and the serum potassium 4.35 mEq/liter. Total protein was 8.8 gm/100 cc., albumin 2.5 gm/100 cc., and globulin 6.3 gm/100 cc. Subsequent urinalyses were normal. Subsequent hemograms revealed white blood cell counts ranging from 4600 to 9300 and the red cell count and hemoglobin content varied from 4,890,000 and 14 gm. to 3,710,000 and 11.5 gm., respectively. Serum bilirubin and alkaline phosphatase were normal, and thymol turbidity was 6 units. A tuberculin test was positive in the initial strength, and skin tests for Coccidioides immitis and blastomycetes were negative. Subsequent biopsies of the cutaneous lesions of the nose and left index finger showed Coccidioides immitis in the histological sections. A complement fixation test for Coccidioides immitis was positive 41 days after admission. Chest x-rays on admission revealed calcifications in the right hilar region. X-rays of the left index finger revealed bony erosion along the lateral border of the distal portion of the terminal phalanx. Laminograms of the larynx revealed subglottic extention of the disease.

The patient received 150 mg. intravenous injection of dihydroxystilbamidine four times daily for a total of 20 doses. Three months after completion of therapy there was healing of the cutaneous lesions. The structures of the endolarynx remained involved in a considerable degree, with the epi-

Fig. 4.—Planogram of larynx showing heavy subglottic infiltration by the granuloma at time of admission.

glottis, both ventricles, and true cords exhibiting extensive involvement. A combination of the processes of resolution of edema and slight healing by scar formation resulted in widening of the rima glottidis, making tracheotomy no longer necessary.

DIFFERENTIAL DIAGNOSIS

The characteristic, though not distinguishing, clinical appearance of this case is that of an ulcerative granuloma of the larynx, pain-

Fig. 5.—Planogram of larynx showing subglottic infiltration after three months of therapy.

less in character, showing tendency toward healing and scarring. The laryngeal lesion in this case was accompanied by cutaneous lesions of the hands and face in which there were histological demonstrations of Coccidioides immitis. The differential diagnosis of this type of laryngeal lesion must exclude lupoid laryngeal tuberculosis, blastomycosis, syphilis, and cancer as the foremost considerations. The differential diagnosis is, of course, a histological one, as clinically these diseases may be indistinguishable. Positive microscopic identification of the organism by growth and isolation on Sabouraud's medium or Littman's oxgall agar and a positive complement fixation test are essential laboratory aids.

SUMMARY

A case of chronic disseminated granulomatous-type coccidioidomycosis involving the skin and larynx is reported. This is believed to be the first published report of the disease involving the structures of the endolarynx.

A brief sketch of the pathogenesis and differential diagnosis is included. No attempt is made in this report to evaluate the efficacy of dihydroxystilbamidine in the treatment of this disease, although the case reported has shown mild clinical improvement.

Carol Sherman assisted in the preparation of this paper.

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Primary Grafting of Fenestration and Mastoidectomy Cavities

Additional Experience with Primary Grafting of Fenestration, Modified Radical and Radical Mastoidectomy Cavities

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In a previous report,[12] results with 46 cases of radical mastoidectomy cavities were given by me and my associates. A dry epithelized cavity resulted in 9.3 weeks in primary skin-grafted cases as opposed to 25.6 weeks in the nongrafted control group. A technique for using a petrolatum (Vaseline)-paraffin gauze mold for "gloving" the split graft was presented. This technique facilitated placement of the graft and sealing of the Eustachian-tube orifice. In recent months, I have utilized immediate split-thickness grafting in 33 additional cases. In this group were 10 radical mastoidectomies, 8 modified radical mastoidectomies, and 15 fenestrations. Resulting early "dry ears" would further support the routine practice of primary grafting and tend to confirm the beneficial trend noted in the previous series.

Various authors have advocated the use of primary split-thickness grafting in recent writings. This procedure has been advocated by Farrior, Harris and Meadows, Jones, Harbert, Adin (who also uses a cancellous bone graft to the Eustachian tube), Williams, and Antoli-Candela. The surgery included both mastoidectomies (endaural and postauricular approach) and fenestrations. Various series were from 14 or 20 cases to 150 each. It was generally agreed that routine primary grafting should be performed in the above procedures. From their series of 150 cases of mastoid and fenestration cases Harris and Meadows [9] found that "post operative care has been shortened to an average of 4 to 6 weeks, as contrasted with 2 to 4 months prior to the use of this method."

Taking a somewhat different view of the procedure, Boies,[8] as well as Guilford and Wright,[7] advocates the use of delayed skin grafting. In 100 cases of nongrafted fenestration cavities, the latter two authors found healed cavities in an average time of 4.4 months (approximately 18 weeks), whereas the secondarily grafted cavities in 60 cases healed in 1.7 months (approximately 6.8 weeks).

It would be of interest here to recount why a skin graft "takes" in these cavities, also why it is that a thin graft "takes" better than a full-thickness graft. Most authors * agree that such is the case. Harbert has outlined the mechanism of how the graft takes:

1. "Stage of Fibrinous Fixation"—This occurs in the first 24-48 hours, during which time the graft is nourished by plasma. Hence a thin graft would have a better chance.
2. "Stage of Endothelial and Fibrotic Proliferation"—This occurs in 18 hours to 10 days while fibroblasts and endothelial cells invade from the recipient site.
3. "Stage of Exfoliation"—This occurs in 8-20 days and is less with a thin graft. Harbert has found the cavity "usually completely healed and dry by the end of the 4th week."

Harris and Meadows,[9] utilizing work by Grace [6] to back their use of thin split-thickness grafts, point out the following. The most active reproduction of cells in the skin (as noted by the number of mitotic figures) is in the lowest part of the prickle-cell layer. Nourishment from the recipient site would

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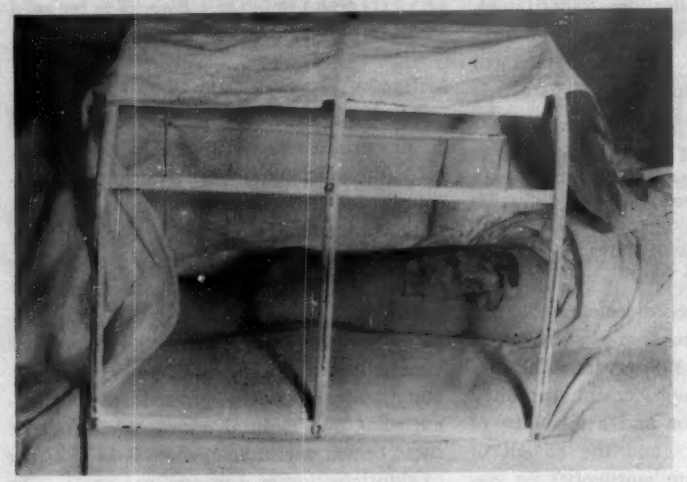
* References 8, 9, 12, and 13.

not reach this layer in sufficient amount if full-thickness grafts were used. They took biopsy specimens from the center of the grafted areas. These cavity biopsies were made at two, four, six, and eight weeks in various cases. In each case when the specimen was examined microscopically "viable skin" was reported.

Before discussion of results, a few remarks about the technique of grafting should be made. Details of taking and placement of the immediate split-thickness graft have been described elsewhere [13] and will not be repeated. The mold of petrolatum gauze is used for radical mastoidectomies, and the technique described by Farrior of "papering" the cavity with rayon-backed strips of skin is used for modified radical and fenestration cavities. I have found it helpful to overlap the tympanomeatal flap with the free rayon end of these strips. With the flap thus covered, no "sleeve" is necessary to protect the flap for insertion or removal of the cavity packing. Antibiotic-impregnated, sterile sea-sponge pieces are used to pack the cavity to hold the graft in place, and in fenestration cavities exert even pressure on the flap and fenestra. The sponge pieces are first "tagged" with a black nonabsorbable surgical (silk) suture to facilitate removal.

Mastoidectomy cavities are left undisturbed for three weeks (modified and radical) unless excessive discharge, swelling, or pain supervenes. Sutures are removed at five days and only the head dressing is changed. This procedure ensures a better "take" than disturbing the cavity to unpack at the end of five to seven days.

In fenestration cases the problem is somewhat different. To begin with, one is dealing with a sterile wound; hence healing and graft "taking" is more rapid. In addition, one is anxious to inspect the condition of the typanomeatal flap, as well as to decompress the cavity at the end of five days. For these reasons the fenestration cavities are unpacked on the fifth day postoperatively instead of at the end of three weeks. Aseptic technique in caring for all cavities is continued for one month postoperatively. The cavities are left alone inside, insofar as possible.



"Dry-heat" treatment (with standard heat cradle) to the donor site of the split-thickness skin graft after 48-hour pressure dressing. Note with drying the rayon covering has begun to detach from the raw surface, leaving a clean dry "scab."

One distinct improvement has been made since the last communication, namely, in the postoperative care of the donor site on the leg. Healing of the donor site is greatly facilitated by early "drying" treatment. At the end of 48 hours, pressure dressing is removed from the leg and exposure to a standard heat cradle started. It is of the

type (Figure) widely available in most hospitals. The surgical rayon is left attached to the raw wound. Over a period of two to three days of dry heat, this strip becomes dried, disengages from the skin surface, and may be "teased" off painlessly by the patient (Figure). The patient then leaves the hospital on the fifth to the seventh day with the donor site covered with a dry "scab." This gradually peels away and is replaced by new skin in approximately two weeks postoperatively. The incidence of secondary infection in the donor site has been nil after the "dry" treatment was started. The healing time is almost cut in half.

Results with immediate split-thickness skin grafting have been as follows in the present 33-case series (10 radical mastoidectomies, 8 modified radical mastoidectomies, and 15 fenestrations). The following statement should be recalled from the previous article by my associates and me [13]:

> A definition of "healed cavity" or "dry ear" is in order. For our purposes, these terms mean a cavity that has epithelialized, leaving no discernible granulation tissue or purulent exudate. The patient is not conscious of drainage from the ear. We consider such a one a "healed cavity."

In the 10 radical mastoidectomies, a dry ear resulted in 8.6 weeks—a slightly better time than the 9.3 weeks observed in the preceding series. (This improvement is credited mainly to improvement and availability of locally used antibiotics and the advent of various "broad-spectrum" antibiotics for systemic use. Both facilitate healing in mastoidectomy surgery.) There is still considerable difference between healing in 8.6 weeks and 25.6 weeks, noted in our previous ungrafted control group.

In the group of 8 modified radical mastoidectomies and 15 fenestrations, the healing time required for a "dry ear" was even less: 6.5 weeks for modified radical mastoidectomies and 4.2 weeks for fenestrations. Of course, the utilizable typanomeatal flap in these cases speeds healing of the cavity. In addition, they are "clean" cases as compared with the radical cases. In the radical mastoidectomies, the drum was frequently replaced by granulations, the infection of longer standing, and the dissection of the cavity larger. Of ungrafted fenestration cavities Kos [11] wrote: "The cavity is usually completely epitheliated and dry within three months [12 weeks]."

Harris and Meadows [8] found "an average of 2 to 4 months" (8 to 16 weeks) necessary for healing in the control group (this included both mastoidectomy and fenestration cavities).

Guilford and Wright [7] found in 100 cases of fenestration cavities not grafted the "average healing time 4.4 months" (17.6 weeks).

It would seem then that primary split-thickness grafting of modified radical mastoidectomies and fenestrations is worth while. Dry ears result in 6.5 to 4.2 weeks as opposed to 12, 16, or 17.6 weeks in ungrafted cases.

COMMENT

My experience, as well as the consensus of numerous reports in the literature, upholds the principle of skin grafting mastoidectomy and fenestration cavities. The procedure is of undoubted value in early healing and shortened postoperative care. No attempt has been made here to enter into the controversy of immediate *vs.* delayed grafting. One thing is obvious from 10 years' experience in dealing with ungrafted, primary and secondarily grafted cases (postauricular and endural approach): None of these healed operative cavities is as resistant to skin infection as a normal ear canal. The ones which do secrete cerumen do not "shed" it readily. They all require periodic inspection, cleaning, and treatment. To me it is simpler to utilize primary grafting (which consumes 10 to 15 minutes' operating time) and thus avoid a secondary operation.

SUMMARY

Review of current literature on skin grafting mastoidectomy and fenestration cavities is presented.

Basic histological studies by Harbert and by Harris and Meadows indicate a thin graft is more suitable than a thick graft approaching full thickness of the skin. My experience

(without histological proof) would confirm this concept.

A cavity mold made from paraffin-petrolatum (Vaseline) gauze is advocated for "gloving" the skin graft for radical mastoidectomy cavities; for modified radical and fenestration cavities, strips of skin backed with rayon after Farrior's technique were used. No "sleeve" to protect the flap was required.

"Dry" treatment of the decompressed donor site on the leg at the end of 48 hours gave a healed uninfected "scab" before dismissal from the hospital (heat cradle used). No cases of donor wound infection were noted.

Results were as follows: (*a*) in radical mastoidectomy, a dry ear in 8.6 weeks, instead of 25.6 weeks in ungrafted cases; (*b*) in modified radical and fenestration cases, a dry ear in 6.5 and 4.2 weeks, instead of the usual 12, 16, or 17.6 weeks in ungrafted cases, as reported by other authors.

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Rhinoplastic Sequelae Caused by Patients

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Rhinoplastic surgeons not infrequently after a satisfactory operation are confronted by patients who complain of a new deformity. The surgeons are aware that after removal of dressings the nose appeared satisfactory. When the patient returns on subsequent visits a change is sometimes noted in the shape of the nose, which is attributed to the reparative healing process. On occasions undue tissue reactions are seen. By careful questioning it soon appears that the patient failed to mention that postoperative trauma occurred. Rarely does the patient freely admit that the damaged nose was struck accidentally or intentionally.

The following are some examples:

CASE 1.—Two weeks following a satisfactory rhinoplasty, the patient, a physician's daughter, returned accompanied by her father. There was swelling of the bony and upper cartilaginous vaults. She was casually asked if there was any cause for this surprising effect. She admitted that one night the lights were out in her room and she collided with a door.

CASE 2.—Ten days following a rhinoplasty the dressing was removed. The nose appeared satisfactory, except for slight postoperative edema. Three days later the patient returned. The nose was unduly swelled. She was questioned and admitted that her baby had struck her nose a number of times, following which a sudden increase in swelling occurred.

CASE 3.—About four months after a satisfactory rhinoplasty the patient returned with a depressed tip and complained of epistaxis. On questioning it was revealed that while he was playing basketball the ball eluded his grasp and struck his nose.

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CASE 4.—One week following a rhinoplasty, and with the dressing still in place, the patient decided to go to a popular resort for a week end. In order to freshen the adhesive tape over his recently fashioned nose, he covered up his entire dorsum and tip with several pieces of additional adhesive tape. In doing so he placed one long piece directly over and across the tip of his nose. He was seen three days later. Not only was the tip depressed and drooping but there was also a groove-like depression above the tip. The nose was restrapped and the self-inflicted deformity was corrected.

CASE 5.—Nine weeks following a nasal correction the patient's father phoned for an appointment, stating that he believed his daughter's nose did not appear so satisfactory as shortly after the operation. When she arrived at the office examination revealed a flattened, depresesd tip with overlying inflamed skin. The change was incredible as compared with its appearance two weeks previously. After questioning she confessed that she "banged" her nose with her hand. On her return one month later it was seen that the edema had subsided but the appearance of the nose was still unsatisfactory. Plans were made for a surgical revision during her vacation. On her return six months later the nose appeared so satisfactory that no operation was deemed necessary.

CASE 6.—The patient had a nasal correction, with a satisfactory result, and was examined in the first two weeks at the Rhinoplasty Clinic of the Mount Sinai Hospital. Three months later he returned with a drooping tip. Close questioning elicited the information that the only position in which he could sleep was on his stomach and face; he could not sleep on his side or back. The pressure on his tip was unquestionably the factor that caused it to become depressed.

Occasionally a patient returns a year or more after the nasal correction and complains about the result. Here also the surgeon must be alert and thoroughly quiz the patient. The following is an example.

CASE 7.—Previous to the operation the nose was deviated. A simultaneous rhinoplasty and septum operation corrected the deformity. The nose at this time, two years later, was obviously deviated. After

thorough examination, including inspection, palpation, and roentgenography, and questioning the patient admitted that during an argument with her husband he struck her on the nose.

The tendency of a husband to strike his wife on her newly corrected nose is not unusual in my experience. This provocative

Note fractured dorsal iliac implant and undisturbed columellar batten.

act occurs when there is a family argument and the husband decides to reduce the ego of his beautiful wife.

Another recent example is of interest.

CASE 8.—Nineteen months previously I revised an operation which was performed elsewhere. It was necessary to utilize an autogenous cancellous iliac graft. The result was satisfactory. The patient went South and returned. She complained of deviation of the graft and a slight saddle of the dorsum. I suggested a roentgenographic examination. This revealed a fracture of the dorsal graft. Here also the patient after viewing the roentgenogram admitted that she suffered a blow on the nose inflicted by a jealous suitor.

Another contributing factor in acquired deformities following a good rhinoplastic correction is what may be called the romantic factor.

CASE 9.—A male patient, one month following a rhinoplasty and septal reconstruction, returned because of epistaxis. He admitted that the tip of his nose was accidentally struck by his girl friend's head two weeks previously and again one week previously.

Rhinoplastic surgeons must be on the alert when a previously satisfied patient appears with a postoperative deformity. As soon as postoperative edema subsides photographs should be taken and kept in the files. They provide proof, if necessary, that the surgeon accomplished a gratifying result. Unusual postoperative reactions, abnormalities, and delayed deformities occurring in patients who had a good result should arouse suspicion. The surgeon should elicit a detailed history regarding the responsible factor. A proper sympathetic approach with suggestions for correction of the condition usually induces a confession. This solves the mystery of the cause of the deformity, which is frequently and unjustifiably attributed to the surgeon.

SUMMARY

Many rhinoplastic sequelae attributed to the surgeon are caused by accidents not revealed by patients. The surgeon should be vigilant regarding these possibilities when undue changes occur in the appearance of the nose after properly performed corrective nasal surgery.

Frontal Sinus Drainage

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Over the years various operations have been devised to deal with cases of chronic frontal sinusitis. The fact that so many procedures have been described shows that none is entirely satisfactory in all types of cases.

Quoting from a recent article by Woods [1]:

> These operations range from the completely obliterative operation of the Riedel type at one end of the scale, to the simple drainage operation of the Howarth type at the other. Occupying the midposition we find the Killian operation and its modifications, making an effort at both obliteration and drainage. The obliterative type of operation cures the disease, but is ruled out of ordinary practice by the deformity it creates. The drainage type of operation produces no deformity, but leaves the disease still in situ, and is in fact frankly palliative, aiming at relieving the patient of his symptoms without eradicating the disease. Practically every writer on this subject emphasizes the necessity of preserving or enlarging the frontal duct, and many operators use a graft or a prosthesis in an effort to maintain its patency.

Tato,[2] of Buenos Aires, has added an original note to the obliterative operation described by Woods. After carefully removing all the mucous membrane from the frontal sinus, he fills the cavity with fat, gelatin sponge, fibrin sponge, etc., to the extent of its capacity. This avoids a "dead space" with limited drainage and favors the organization of fibrous tissue by absorbing and holding any blood clot that forms. Theoretically these operations are sound and there should be no recurrence, provided, of course, that the sinus mucosa is removed (not curetted) and the nasofrontal duct is closed off.

A later article by Goodale [3] again stressed the importance of removing every vestige of mucous membrane from the frontal sinus, in order to avoid the danger of reinfection with the development of pyoceles or osteomyelitis. In view of the radical nature of these procedures it would seem that they should be reserved for cases where simple drainage it not sufficient or where reinfection has occurred.

It is generally agreed that any external operation should be avoided in acute cases or during a flare-up of an old chronic infection unless intracranial complications appear imminent. Under these conditions with blockage of the nasofrontal duct a simple trephine opening in the floor of the frontal sinus and the insertion of a drain is usually sufficient. In spite of the antibiotics it is still considered wise to postpone any radical procedure until the acute phase has subsided.

In chronic cases where a drainage operation is considered, there is still a great deal of controversy as to the type of procedure to be carried out. Various methods with tubes or obturators have been used to keep the nasofrontal duct patent. These include metallic, rubber, and synthetic tubes, acrylic obturators, tantalum foil, etc., depending on the individual operator.

Kernan [4] stated in his book:

> The most popular and successful operation is one that removes the floor only, without disturbing the anterior wall, which in a great measure eliminates the possibility of osteomyelitis of the skull. To Jansen [5] belongs the credit of first describing in 1893 the cardinal principles and technique of such an operation. Knapp [6] in 1909 reported a successful case, but it was Lynch [7] in 1921 who vigorously put forward the advantages of this type of operation. Sewall,[8] in 1926, published his technique which has

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been amplified and refined by Ferris Smith [9] and others.

Mucous membrane flaps as described by Sewall [10] and again by Boyden [11] give excellent results. Nearly 15 years ago (1941) J. Mackenzie Brown [12] reviewed the subject and outlined the various forms of treatment. He favored a large rubber tube to keep the nasofrontal duct patent and left it in place about two weeks. The sulfonamides were given by mouth to lessen the chance of infection. This was about a year before penicillin was available for civilian use. He also stated, "Mucosal grafts as advocated by Sewall are of distinct advantage."

Frontal sinusitis, especially the acute variety, seldom occurs alone but is usually associated with infection in the ethmoids and often the antrum.

Recurring attacks of frontal sinusitis without proper treatment tend to become chronic, with permanent thickening of the lining membrane. Because of the lack of ventilation and drainage reinfection is likely to occur in the presence of a severe head cold or, at times, after swimming. As a result, in a certain percentage of cases complications are bound to occur in spite of our wide range of antibiotics and greater knowledge of nasal physiology.

In cases of recurrent frontal sinusitis it is a good policy to correct any predisposing anatomical irregularity, such as a septal deviation or a bulbous anterior end of the middle turbinate, during a quiescent period. Any obstructing polypi should also be removed. Fracturing the middle turbinate to the midline as an office procedure often gives more space in the middle meatus and facilitates drainage.

Today most people, especially in the larger cities, seek advice early, so that the radical operations of Killian, Riedel, Sebileau, Lothrop, Lynch, etc., to mention a few, are rarely needed. They are reserved for chronic cases where there is a danger of complications and extensive trauma involving the frontal sinuses. However, when these operations are necessary to obliterate a cavity or remove bone to eradicate osteomyelitis, they are not the disfiguring procedures of the past, owing to our modern methods of plastic surgery.

In the "drainage" type of operation on the frontal sinus or where there is recurring ethmoiditis following intranasal ethmoidectomy most operators at the present time feel the external approach to the frontal sinus gives the best results. After the frontal sinus has been attended to, the anterior ethmoid cells can be thoroughly opened with punch forceps under direct inspection. The external operation is far superior to any intranasal method of dealing with the frontal sinus, for no operation through the nose can do more than promote drainage of an infected frontal sinus nor can with certainty reach all the ethmoid cells.

Of all the external operations on the frontal sinus that have been devised over the years, simple permanent drainage of the sinus with the neighboring frontoethmoid cells by means of a large catheter or tube is perhaps best. Primary closure of the wound results in little or no scarring.

Many modifications and refinements in the technique of the operation have been introduced and discarded from time to time. Each operator develops his own particular method which in his hands proves successful in the great majority of cases. The following procedure has worked well in my patients. The technique is by no means original. I use a split-thickness skin graft over a polyethylene tube.

Whether the operation is carried out under local or general anesthetic is a matter of choice. My choice as a rule is general anesthesia. The patient is premedicated with pentobarbital (Nembutal), morphine, and atropine or scopolamine in appropriate doses. The induction is carried out with intravenous thiopental (Pentothal) sodium and a relaxant (curare, suxethonium dibromide [Brevidil], or anectine) and the patient intubated. Anesthesia is maintained by a thiopental intravenous drip supplemented by varying mixtures of nitrous oxide, cyclopropane, ether, and oxygen, depending on the preference of the individual anesthetist. Whichever

method is used, pledgets of absorbent cotton dipped in epinephrine with or without cocaine and placed high up in the nose anteriorly tend to reduce the bleeding. (When cyclopropane is used epinephrine should be avoided.) The number of pledgets inserted is recorded.

As a preliminary step a split-thickness graft approximately 2×1½ in. (5×3.7 cm.) is taken from the inner surface of the patient's thigh and kept moist with Ringer's solution in gauze.

Although some operators shave the eyebrow, this seems quite unnecessary. It is convenient to mark the line of incision with an applicator dipped in methylrosaniline chloride (gentian violet) or strong silver nitrate solution (25%-50%), or by using the back of the scalpel blade. A little procaine hydrochloride with a few drops of epinephrine injected into the site of the incision tends to lessen the hemorrhage.

The incision begins above at the upper border of the internal angle of the orbit, just below the eyebrow and medial to the supraorbital notch. In this way the nerve is not damaged and postoperative anesthesia in this area is avoided. The curved incision cuts through the skin, soft tissues, and periosteum down to the bone. All active bleeding points are tied off.

Although it may seem superfluous, at times it is important, even for an experienced operator, to know at a glance the level of the cribriform plate. On questioning Dr. C. P. Martin, Professor of Anatomy at McGill University, concerning this level, he made the following remarks:

The cribriform plate of the ethmoid is not completely flat but usually curves slightly upwards, both anteriorly and at the sides. The central and lowest part of the plate is virtually parallel with Reid's base line,* that is, a line cutting the lower margins of the bony orbits in front and passing through the middle of the external auditory meatuses behind. The cribriform plate is situated at the level of a line joining the inner canthi of the eyes.

In other words, from a practical point of view it is important to remember an imaginary line from the middle of the external auditory canal opening to the lower margin of the orbit. Also, the level of the inner canthus of each eye is at least ½ in. (1.2 cm.) above Reid's base line in the average adult.

A spectacle frame of average size with plain glass is a great aid in determining this level. A horizontal black line is made across each glass, exactly on a level with the inner canthus of each eye. This shows the position of the cribriform plate. Any ethmoid cells below this line can be removed with safety.

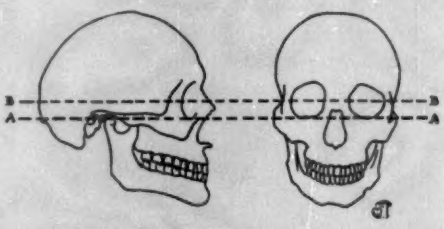


Fig. 1.—*A*, Reid's base line. *B*, level of the cribriform plate. (This line passes through the inner canthus of each eye.)

After the general ooze is controlled by pressure, the periosteum is elevated, care being taken above at the attachment of the trochlea for the superior oblique muscle. The orbital plate of the ethmoid is freed of its periosteum and also the medial portion of the floor of the frontal sinus. The lacrimal sac and upper end of the nasolacrimal duct are separated from the bone and lifted outward from their groove.

When enough bone is uncovered the sinus is entered by means of a mallet and chisel or dental drill. The safest point of entry into the sinus lies just above the groove for the lacrimal sac and on a level with the roof of each orbit. If a piece of bone is removed from this area about the size of a cherry stone, it almost invariably enters the sinus. (This has been shown in hundreds of specimens.)

* Reid's base line[13] (Robert William Reid, Scotch anatomist, died in 1851) is a line drawn from the lower margin of the orbit to the auricular point (center of the aperture of the external auditory canal) and extending backward to the center of the occipital bone.

Fig. 2.—Spectacle frame recommended for ascertaining the level of the cribriform plate.

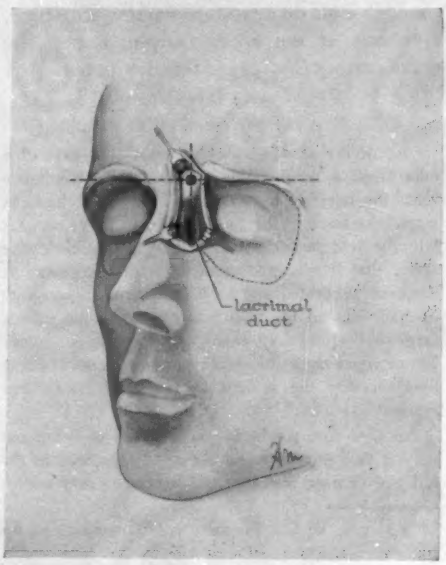
The opening is enlarged by means of punch forceps, the extent of the sinus and appearance of the lining noted and whether or not pus or polypi are present. Bone is now removed toward the septum between the frontal sinuses and above to the level of the orbital roof. Laterally the supraorbital notch acts as the outer boundary, and the intervening bone can be safely removed just short of this landmark. When a large sinus is present it is sometimes necessary to sacrifice the nerve. Below, a portion of the nasal bone is taken away and part of the ascending process of the superior maxilla. The opening into the nasal fossa is made bigger and any loose pieces of nasal mucosa excised with scissors. It is important to enlarge the opening downward, and backward as far as the outer or posterior edge of the nasolacrimal duct. Above, it is often necessary to remove the lower part of the groove for the lacrimal sac with punch forceps in order to insert a large enough catheter or tube from the nose to the frontal sinus.

At this point some more of the thick ascending portion of the maxilla may have to be removed to expose the orbital plate. All diseased frontoethmoid cells are opened up and the anterior end of the middle turbinate, if necessary, taken away. If the posterior ethmoid cells and the sphenoid are also involved they can be attended to at the same time. The anterior and posterior ethmoid arteries are two landmarks which show the level of the cribriform plate. In dealing with the frontal sinus it is comforting to know that when the anterior ethmoid artery comes into view all infected cells below this point can be removed with complete safety. The mucous membrane of the frontal sinus and septum is preserved as much as possible unless it is polypoidal, and if the epinephrine pledgets are still in the nose they should now be lifted out and counted.

An appropriate-sized polyethylene tube about 10 mm. in diameter is now selected. The skin graft is removed from the gauze and is wrapped with its raw surface outward around the tubing. The easiest way to accomplish this maneuver is to spread the skin on a piece of gauze with its smooth side upward and roll the skin onto the tubing as one would roll a cigarette. The rectangular graft is applied with its greater length parallel to the axis of the tube.

Absorbable surgical (gut) sutures (00 or 000) are used to sew the graft to the tube, because they are absorbed in from 7 to 14 days. It is important to attach the upper portion of the graft securely to the tube to prevent it from sliding back upon itself when introduced from below. Provided the

Fig. 3.—The cross hatched circle shows the site of trephine opening. When the sinus is entered bone is taken away anteriorly, posteriorly, and inferiorly.



upper end is properly sutured, it is not necessary to secure the lower. The graft is applied so that it leaves the distal end of the tube free; this bare area is left to project into the sinus, and on occasions in a very large sinus the uncovered portion is perforated to facilitate drainage.

The prepared polyethylene tube is now introduced through the nose up into the frontal sinus. When ideally placed the skin graft should just reach the floor of the frontal sinus. It is wiser to have it project slightly into the sinus than be too short. The lower end of the graft should be well into the nose. Any excess tubing is then cut off flush with the anterior nares.

My feeling has been that the graft takes relatively well through its entire circumference. Negus,† however, doubts that the primary graft takes posteriorly. The external incision is now closed with subcutaneous absorbable and nonabsorbable (silk) or Dermalon (skin and tension suture processed from nylon) sutures. No drain is usually inserted into the line of incision. A pressure dressing is applied for 48 hours and the patient given the appropriate antibiotic. The polyethylene tubing is left in situ for four to six weeks. When the tube is removed there is usually an adequate epithelized channel. This duct tends to narrow with time, especially at the lower margin, but in the great majority of cases remains patent.

REPORT OF CASES

One of my most successful cases was that of a man from a neighboring town. On his discharge from the hospital he was asked to report back in six weeks to have the tube removed. Three months later he returned to the city for the first time. He stated that it was inconvenient for him to report at the time suggested and as there was no discomfort he had delayed his visit. On removing the tube a large well-epithelized canal was seen. It is a number of years since this occurred, and on questioning him recently the patient said he had no further trouble.

Another case might be summarized to bring out one or two points. A middle-aged man was in the habit of visiting the office at least once every winter complaining of pain over the left frontal sinus following a cold. The history was always the same: intermittent blocking of the nose on the affected side with an occasional discharge of yellow pus. Simple shrinkage of the left middle meatus, ephedrine nose drops, and heat were effective in the early stages. In recent years it was necessary to fracture the middle turbinate toward the midline to get adequate ventilation and drainage. Vasoconstrictor drops, injections of penicillin, and heat were also required. Three years ago last March he appeared with the left eye partly closed and a marked swelling over the eyebrow. On palpation there was no fluctuation apparent but the fullness was quite boggy and tender to the touch. In spite of the usual conservative treatment and massive doses of penicillin, no drainage or relief of pain was obtained. An x-ray at this time showed a large left frontal sinus which was uniformly blurred, with an indistinct outline. This was partly due to the edema over the sinus. The right frontal sinus was clear throughout and appeared to be quite normal.

The patient was operated upon following the technique described above. On exposing the bone over the lower part of the sinus a thin trickle of pus was seen which came from a fistula on the anterior wall. In view of this opening the incision was extended upward a little higher than usual. By means of a probe the fistula was explored. The septum between the sinuses appeared to be intact; so it was left alone. In spite of the fistula, the sinus was opened from below, and although the mucous membrane in some areas was markedly thickened and slightly polypoidal, it was not disturbed.

The fenestrated tube was carried up from below and placed in the outer corner of the large sinus. The external wound was sutured up tightly and the dressing applied. On admission the patient's temperature was 101 F, but within a day or two after operation it dropped to normal and remained there. In view of the fistula and the presence of pus it was thought wise to irrigate the sinus. This was done by inserting a small No. 8 soft rubber catheter through the drainage tube and syringing gently with warm saline.

The outer dressing was changed in 24 hours, and on the fourth day the alternate sutures were removed. The remaining stitches were taken out on the sixth day. Adequate doses of penicillin were given postoperatively but apart from that no further treatment was necessary, and the patient made an uneventful recovery.

The polyethylene tube was removed six weeks after the operation. An x-ray taken three months later showed the sinus to be clear, with no evidence of the fistula present. The patient has remained symptom-free since that time (three and one-half years).

† Negus, V. E.: Personal communication to the author.

Fig. 4.—X-ray film showing a 10 mm. polyethylene tube covered with a skin graft in the right nostril and into the infected right frontal sinus. As there was a fistula in the inter sinus septum, this opening was enlarged and the tube inserted through the septum to the outer corner of the left frontal sinus.

COMMENT

It should be mentioned that this type of operation is equally suitable for large or small frontal sinuses provided a big enough opening is made to ensure permanent drainage. In cases where the septum between the sinuses is perforated and the frontal on the other side is involved, the same procedure is sufficient. The remaining portion of the septum is removed with punch forceps and the tube carried through the opening to the outer limit of the other sinus. Equally good results are obtained by draining both sinuses through one side of the nose.

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Cricoarytenoid Ankylosis or Laryngeal Paralysis?

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Cricoarytenoid ankylosis is easily mistaken for laryngeal paralysis. In neither condition can the patient move the vocal cord. In laryngeal paralysis, he cannot move it because he has lost motor nerve supply. In cricoarytenoid ankylosis, he cannot move it because the posterior attachment of the vocal cord is solidly fixed at the cricoarytenoid joint.

The "passive-mobility" test of Jackson will differentiate between the two conditions.[1] Ankylosis of the cricoarytenoid joint immobilizes the arytenoid cartilage so that it cannot be displaced outward by the tip of a laryngeal forceps; in laryngeal paralysis such displacement is easily possible. In unilateral cricoarytenoid ankylosis, the general region of the arytenoid joint may appear different from the opposite side and thus give some indication of the pathologic change. Another diagnostic point concerns the ventricular bands, which in cricoarytenoid fixation may move and approximate each other in the midline but in laryngeal paralysis generally cannot. Differentiation by history alone is usually not possible. However, cricoarytenoid ankylosis is seen in conditions involving laryngeal infections and trauma. Laryngeal paralysis, on the other hand, is usually associated with injury to the recurrent laryngeal nerve. Some cases of ankylosis are said to be the end-results of arthritis of the cricoarytenoid joint.

In every paper reviewing laryngeal paralysis, a certain percentage of cases is assigned to idiopathic or unknown causes. Some cases of so-called idiopathic laryngeal paralysis are probably unrecognized cases of cricoarytenoid ankylosis.

Recently there have been several reports in the European literature concerning cricoarytenoid ankylosis,* but in the American literature reports are rare. In my opinion, this condition is diagnosed infrequently, not because of its rarity but because it is overlooked.

In the past year, three cases of cricoarytenoid fixation have been recognized at The Ohio State University Medical Center. Two of them were believed to be due to old diphtheritic infections of the larynx. Both patients had one cord fixed firmly in the midline. In neither patient did the ankylosed cricoarytenoid area appear different from the opposite side. But when the passive-mobility test was done, it was found there was no movement at the cricoarytenoid joint. The cases were discovered incidentally as part of the routine otolaryngologic examination. The third case is unusual and is reported in detail.

REPORT OF A CASE

A 50-year-old white woman ingested an overdose of sleeping pills and was admitted to the neurosurgical service July 17, 1954, in comatose state. Except that the patient was in coma, the general physical examination was negative.

Management included the administration of oxygen through an intratracheal tube and feeding through a nasogastric tube. Lobar pneumonia developed soon after the patient was hospitalized. She was treated with intramuscular penicillin and intravenous chlortetracycline (Aureomycin). After a

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* References 2 and 3.

stormy course, the patient regained consciousness on her fifth day in the hospital and the nasotracheal tube was removed for the first time. At this time the attending physicians noticed that the patient did not speak above a whisper, but they did not examine the larynx. The patient did not complain of dyspnea. She was discharged from the hospital two weeks after admission. Her voice then was still weak, but her other symptoms had cleared.

Five weeks after her discharge from the hospital, the patient noted the onset of dyspnea on exertion. Her voice had improved considerably but was still somewhat weak. She was readmitted to University Hospital on the otolaryngology service. Indirect laryngoscopy showed both cords immobile in the midline. The glottic chink was estimated at 2 mm. Walking caused striking dyspnea, although the patient was comfortable at bed rest. The initial diagnosis was bilateral abductor paralysis. Tracheotomy was advised.

Direct laryngoscopy was carried out with the patient under general anesthesia. When the passive-mobility test was done, neither arytenoid cartilage could be displaced from the midline. The diagnosis was then changed to cricoarytenoid ankylosis, presumably due to the trauma of the indwelling intratracheal tube, infection associated with pneumonia, or both. At subsequent indirect laryngoscopy, it has been noted that the patient often adducts the false cords strongly, a mechanism spoken of by Jackson and Jackson as dysphonia plicae ventricularis.

The patient has refused to consider any operative procedure to improve her airway for fear it might compromise her voice, the volume of which is now nearly normal. The true vocal cords remain fixed in the midline.

SUMMARY

Cricoarytenoid ankylosis may readily be mistaken for laryngeal paralysis. Some cases of so-called idiopathic laryngeal paralysis are probably unrecognized cases of cricoarytenoid ankylosis. The passive-mobility test of Jackson will differentiate between the two conditions.

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Audiology Section

JOSEPH SATALOFF, ASSOCIATE EDITOR

End-Organ Deafness

Diagnosis and Significance

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The differential diagnosis of lesions of the inner ear and of the acoustic nerve is often difficult and uncertain. Any means of clarifying the problem merits attention. The value of carefully interpreted tests of hearing has been emphasized in recent years. Study of the results of tests of hearing has led to the concept of end-organ deafness as an entity which may be distinguished from deafness of neural origin.

The term "end-organ deafness" is widely accepted in current literature, replacing the terms "cochlear deafness," "inner ear deafness," and "inner ear conduction deafness."

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From the Section of Otolaryngology and Rhinology, Mayo Clinic and Mayo Foundation. The Mayo Foundation, Rochester, Minn., is a part of the Graduate School of the University of Minnesota.

TABLE 1.—*Mygind's Classification of Ear Lesions**

	System		
	I	II	III
	Aero-tympanic	Humoral	Nervous
Anatomic division	Outer and middle ear	Labyrinth and nerve	Labyrinth and nerve
Physiologic division	Sound conduction	Sound conduction	Perception
Deafness	Bass	Bass	Treble
Bone conduction	Prolonged	Shortened	Shortened
Tinnitus	—	+	?
Diplacusis	—	+	—
Paradoxical upper limit	—	+	—
Vertigo and nystagmus	—	+	†
Sensation of pressure	+	+	—

* From Acta oto-laryng. 35: 108-129, 1947.
† In Group II vestibular function often is varying but preserved; in Group III it generally is lowered or abolished. Functional disturbances are compensated more readily in Group III than in Group II.

Mygind [1] in 1947 presented a classification of deafness which recognized the division of perceptive deafness into two groups: that of end-organ origin, which Mygind referred to as humoral, and that of nervous origin (Table 1).

Other observers had previously described various phenomena now associated with end-organ deafness. Ménière [2] in 1861 called attention to bass deafness in association with tinnitus and vertigo. Shambaugh [3] in 1920 noted the association of hearing loss for low tones and diplacusis binauralis dysharmonica. Pohlman and Kranz [4] in 1924 noted that a person with a tonal gap in his audiogram at threshold did not notice this gap at high intensities. They stated: "Once the threshold of such a range of decreased acuity is obtained it takes comparatively little additional energy to cause the deficiency to seemingly disappear quite completely." Fowler [5] in 1928 described and labeled the phenomenon of auditory recruitment and presented it as a practical test for distinguishing between conductive and nerve-type deafness. Crowe [6] in 1938 noted the variations in degree of hearing loss associated with Ménière's disease. In recent years Dix, Hallpike, and Hood [7] reported a series of cases showing that high degrees of recruitment of loudness were associated with Ménière's disease, while recruitment of loudness was absent, or present only to a slight degree, in cases of neuroma of the acoustic nerve. The same authors [8] later reported that in cases of Ménière's disease recruitment of loudness was associated with decreased ability to discriminate the spoken voice at high intensities.

Both observations were subsequently confirmed by Eby and Williams.[9] Dix and Hood [10] in 1953 described the phenomenon of adaptation. The term "adaptation" refers to the pathologic decrease in loudness response which is observed when the end-organ deafened ear is subjected to continued stimulation.

The characteristics of hearing currently associated with end-organ deafness are as follows:

- Variation in degree of hearing loss
- Bass deafness associated with elevated bone-conduction threshold
- Recruitment of loudness of high degree
- Adaptation
- Reduced discrimination for speech presented at high intensities
- Lowered threshold of pain
- Diplacusis binauralis dysharmonica
- Variations in the difference limen for intensity

PATHOLOGY

Histopathologic studies of the organ of Corti in human ears affected with Ménière's disease have been done. Delay in fixation of the tissue has led to difficulty in interpretation. All observers have reported distention of the scala media. Hallpike and Cairns [11] and Dix and Hallpike [12] reported antemortem degeneration changes in the organ of Corti. Hallpike and Wright,[13] Altmann and Fowler,[14] and Lindsay [15] demonstrated degeneration in the organ of Corti of ears examined but attributed the changes to postmortem artifacts. Lindsay [16] observed the organ of Corti to be well preserved in the ear of one patient who died as the result of a fall during an attack of vertigo. Study of all the reports strongly suggests that changes do occur in the organ of Corti of ears afflicted with Ménière's disease.

A more precise picture of changes in the organ of Corti may be inferred from the report of Lurie, Davis, and Hawkins,[17] who conducted histologic studies on the temporal bones of guinea pigs which had been exposed to intense noise for varying periods. They reported that damage to the organ of Corti is directly proportional to the intensity and duration of the stimulus. The minimal damage noted was change in the protoplasm of the external hair cells. The smallest unquestioned damage was stripping of the mesothelial cells from the undersurface of the organ of Corti. The external hair cells were next involved. Progressively severer changes were separation of the organ of Corti from the basilar membrane, break in continuity of the organ of Corti (usually starting between the cells of Claudius and the cells of Hensen), rupture of the reticular membrane with oozing out of the external hair cells, and, finally, complete disappearance of the organ of Corti, including the inner hair cells. The authors noted that traumatic changes in the organ of Corti were permanent. The changes appeared two days after trauma. Degeneration of nerve cells and fibers in the spiral ganglion began later.

DIAGNOSIS OF END-ORGAN DEAFNESS

Patients afflicted with Ménière's disease are aware of increased hearing disability at the time of an attack of vertigo. Hearing frequently improves during periods of remission of symptoms. This information may be elicited in the history or demonstrated by repeated pure-tone audiograms. Variations in threshold of hearing are the most practical objective index of the progress of hearing in Ménière's disease.

In cases of end-organ deafness the threshold curve for pure tones rises from low to high frequencies or is flat. In cases of perceptive deafness owing to dysfunction of the auditory nerve the threshold curve for air conduction falls in the high frequencies. The threshold curve for bone conduction parallels that for air conduction. End-organ deafness and nerve deafness may coexist. In this event the air-conduction curve is flat or rising in low frequencies but falls off in the high frequencies (Fig. 1).

Recruitment of loudness refers to abnormal increase in loudness response to increased intensity. The term is derived from the fact that loudness sensation is "recruited" by the abnormal ear. In the European literature recruitment is referred to as "regres-

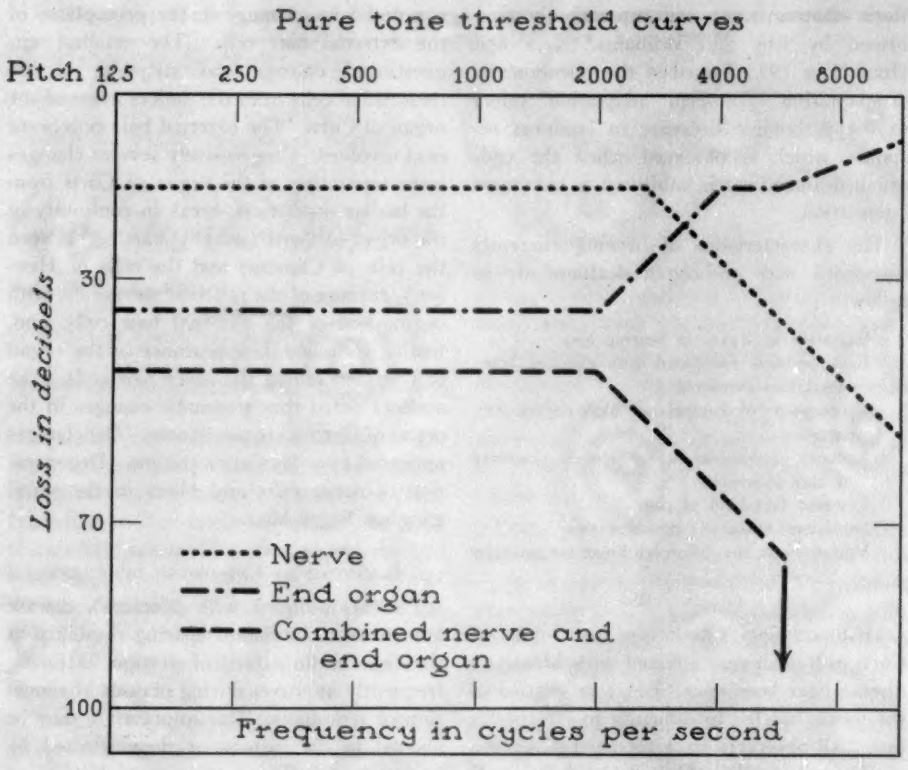

Fig. 1.—Pure-tone threshold curves characteristic of different types of hearing loss.

sion," based on the decrease or regression of hearing deficit at intensities above threshold.

Recruitment of loudness is observed in various forms of perceptive deafness. The degree of recruitment observed is designated by the terms "incomplete recruitment," "complete recruitment," and "overrecruitment." On the basis of results of the binaural loudness-balance test, recruitment which fails to give equal loudness for equal intensities within the limits of the standard audiometer is called "incomplete recruitment." That which produces equal loudness for equal intensities is called "complete recruitment," while that which produces greater loudness sensation in the defective ear at equal intensities is called "hyperrecruitment" or "overrecruitment" (Fig. 2).

Complete recruitment and hyperrecruitment are commonly observed associated with other signs of end-organ deafness. The degree of recruitment observed varies during the course of the disease. In the early stage of end-organ deafness, the degree of recruitment varies with the threshold of hearing. Recruitment may be absent when hearing becomes normal during periods of remission. In the late stage of the disease, recruitment may again be absent.

My colleagues and I have found the alternate binaural loudness-balance test described by Fowler the most practical measure of recruitment for diagnosis of end-organ deafness. In this test a pure tone is alternately impressed on the two ears of the subject while intensities are adjusted to produce equal loudness sensations. The test is more convenient when done with an audiometer which provides two attenuators, or with two separate audiometers. Dix and Hood [10] have pointed out the necessity of presenting the signal in short bursts. The monaural

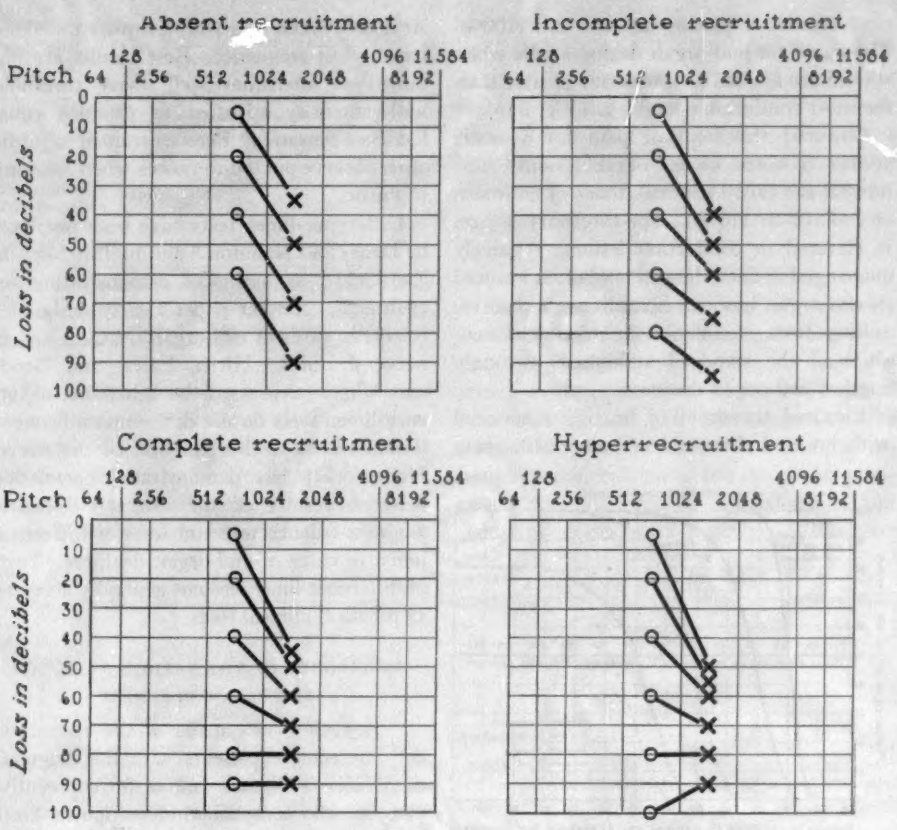

Fig. 2.—Laddergrams depicting various degrees of recruitment of loudness.

loudness-balance test should give similar results when suitable difference in threshold exists between different frequencies. In this test also the tones should be impressed on the ear in short bursts. The masking audiogram which involves continued stimulation of the ear under test theoretically should demonstrate adaptation rather than recruitment in the end-organ deafened ear. We have not used monaural tests in our clinical practice.

Dix and Hood [10] reported that adaptation is present in cases of end-organ deafness and that this phenomenon may seriously influence the results of loudness-balance tests. Adaptation refers to an abnormal elevation of threshold occurring on continued stimulation. It is, therefore, the reverse of recruitment. Dix and Hood reported that recruitment is demonstrated as the "on effect" when a tone is impressed on the ear at full intensity but that adaptation becomes manifest with continued stimulation. In the event that the audiometer provides a slow build-up of intensity after interruption of the tone, adaptation alone may be demonstrated. The phenomenon of adaptation explains the inconsistent results obtained when loudness-balance tests are done by continuous-tone techniques.

The ability to understand the spoken voice varies in different types of hearing loss. This is readily demonstrated by graphic presentation of results of discrimination tests performed at various intensities. The curve for the normal ear rises steeply from threshold to approach 100% discrimination. The curve for conduction lesions is parallel but at greater intensity. The curve for nerve deaf-

ness reaches a plateau at less than 100%. The curve for end-organ deafness falls when stimuli are applied at intensities greater than the most comfortable loudness (Fig. 3).

Lowered threshold of pain for acoustic stimuli is noted in end-organ lesions. The normal ear easily tolerates tones of an intensity of 105 to 110 db. The threshold of pain is elevated in conduction lesions, relatively unchanged in nerve lesions, and often lowered in end-organ lesions. Sensations of pain resulting from stimulation at maximal intensities of the standard audiometer strongly suggest end-organ deafness.

Elevated threshold of hearing associated with lowered threshold of pain results in a

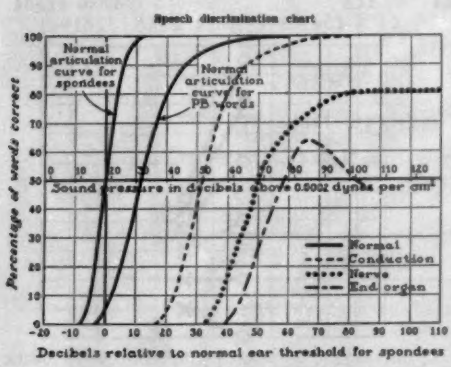
Speech discrimination chart
Normal articulation curve for spondees
Normal articulation curve for PB words
Percentage of words correct
Sound pressure in decibels above 0.0002 dynes per cm²
Normal
Conduction
Nerve
End organ
Decibels relative to normal ear threshold for spondees

Fig. 3.—Speech function curves characteristic of different types of hearing loss.

narrow range of useful hearing or narrow dynamic range.

"Diplacusis binauralis dysharmonica" is the term used to designate difference in sensation of pitch when a pure tone is applied separately to the two ears of a given subject. The phenomenon is observed by some persons suffering unilateral end-organ deafness. Diplacusis may be demonstrated with tuning forks or the audiometer. The tone is usually heard as a higher pitch or as a rough, impure tone by the affected ear. Occasionally the affected ear hears the tone at a lower pitch.

Judgment of diplacusis is difficult for persons who lack appreciation of music. Such persons may confuse pitch with loudness or be quite unable to judge the pitch of the sound. Diplacusis is not usually demonstrated between ears with a similar threshold for the test frequency. Best results are obtained at intensities well above threshold with intensity adjusted to produce equal loudness sensation. Persons trained in music often observe pitch differences when listening to music.

Difference-limen tests have been proposed by Denes and Naunton * and by Lüscher and Zwislocki † as means of demonstrating recruitment. Neither paper clearly designates results in cases of end-organ deafness and of nerve deafness. Hirsh, Palva, and Goodman [20] have expressed the belief that difference-limen tests do not differentiate between lesions of the end-organ and of the nerve. Hedgecock ‡ has demonstrated correlation between results of the alternate binaural loudness-balance test and tests of difference limen in cases of end-organ deafness. Tests of difference limen are not generally accepted as practical clinical tools.

RELIABILITY OF THE VARIOUS TESTS FOR END-ORGAN DEAFNESS

A review was made of the records of 208 consecutive patients with the diagnosis of Ménière's disease and of 39 consecutive patients who complained of vertigo or dizziness and on whom hearing studies were done. The results of hearing tests were noted. Those indicating end-organ deafness were considered to be in agreement with the diagnosis of Ménière's disease. During the period covered by this study the diagnosis of end-organ deafness was considered in each case of Ménière's disease.

The results are summarized in Table 2. Not all tests were done on every patient. The pure-tone audiogram test was done on all patients, other tests being done as indicated. Several tests were done on difficult patients. The percentage of agreement with the clinical diagnosis is similar for all tests except the threshold of pain.

* References 18 and 19.

† Lüscher, E., and Zwislocki, J., quoted by Denes and Naunton.[19]

‡ Hedgecock, L. D.: Personal communication to the author.

TABLE 2.—*Ménière's Disease: Agreement of Hearing Tests with Clinical Diagnosis*

	Agree		Disagree	
	Number	Per Cent	Number	Per Cent
Pure-tone hearing curve *	171	82	37	18
Variability	91	77	27	23
Diplacusis	14	78	4	22
Discrimination	53	77	16	23
Pain threshold †	32	48	22	33
Loudness balance	120	82	26	18

* Ten additional patients exhibited normal hearing when tested.
† Pain threshold of 100 db. or less = agreement; 110 db. or more = disagreement. Thirteen patients (19%) considered indeterminate (105 db.).

The various tests for end-organ deafness do not always agree one with the other, as is shown in Table 3. When multiple tests are done, the majority usually will correlate, although one test frequently is found to disagree with the other tests. In this situation the majority of tests is taken to indicate the presence or absence of end-organ deafness.

Table 4 shows data on dizzy patients not diagnosed as having Ménière's disease. In no patient studied did the majority of tests suggest end-organ deafness.

In summary, end-organ deafness was demonstrated in approximately 80% of 208 patients on whom a clinical diagnosis of Ménière's disease was made. Ten patients whose threshold of hearing was normal at the time of examination were not included in Tables 2 and 3. The patients whose hearing loss was not of the end-organ type showed changes characteristic of nerve deafness. These patients have been deaf for a long time, and it is assumed that degenerative changes in the cells of the spiral ganglion, in the nerve tract, or in both have occurred.

TABLE 3.—*Ménière's Disease *: Agreement of Hearing Tests with Each Other*

Number of Tests	Patients	Agree			Disagree	
		All	Majority	Equal	Majority	All
1	27†	21	..	..	..	6
2	63	40	..	19	..	4
3	46	28	13	..	4	1
4	45	27	11	4	1	2
5	24	5	14	..	5	..
6	3	1	2	..	..	..

* Nineteen patients diagnosed Ménière's disease without endolymphatic hydrops; hearing tests all agreed with clinical diagnosis.
† Ten additional patients exhibited normal hearing when tested.

TABLE 4.—*Vertigo or Dizziness, Not Ménière's Disease: Agreement of Hearing Tests with Each Other*

Number of Tests	Patients	Agree	
		All	Majority
1	24	24	..
2	9	9	..
3	4	1	3
4	2	..	2

CLINICAL APPLICATIONS

End-organ deafness is most commonly associated with Ménière's disease. The presence of deafness of end-organ origin is strong evidence in favor of the diagnosis of Ménière's disease. In this connection the term "Ménière's disease" is used in its limited sense, indicating the symptoms associated with hydrops of the labyrinth and recurring episodes of vascular dysfunction of the labyrinth, but does not include those cases of disturbed equilibrium, loss of hearing, and tinnitus owing to other causes.

During the early stages of Ménière's disease the various manifestations of end-organ deafness fluctuate in degree. Thus deafness of the end-organ type is quite evident during active episodes but may be entirely absent during periods of remission. Later in the course of the disease fluctuations in hearing become less evident, even though remissions of vertigo continue to appear. During this phase the end-organ deafness may persist for many years or hearing loss characteristic of nerve dysfunction may supervene. This leads to the assumption, based on clinical evidence, that the pathologic process in the cochlea is reversible in the early phases of the disease, becoming irreversible at a later stage. Degeneration of nerve cells, fibers,

or both leads to hearing loss of the nerve type.

Thus end-organ deafness may be absent during the early and the late stages of Ménière's disease.

Ménière's disease characteristically results in a progressive decrease of hearing function. Fluctuation in the degree of hearing loss is the most important consideration in the prognosis of end-organ deafness. Remissions induced by therapy usually result in approximately the same degree of improvement of hearing as result from spontaneous remissions. Improvement in hearing does not uniformly result from therapy in those patients in whom the degree of hearing loss has become stabilized. Improvement in hearing cannot be anticipated in those patients in whom loss of hearing is of the nerve type.

End-organ deafness is observed in some cases of deafness of sudden origin. Vascular dysfunction in the cochlea is assumed to be the cause of this hearing loss. Improvement of hearing follows therapy in some of these cases. Sudden onset of deafness of the nerve type is assumed to be caused by occlusion of the cochlear artery or one of its branches. Therapy does not result in improvement in these cases.

The signs of end-organ deafness are characteristically absent in cases of lesions of the acoustic nerve. Dix, Hallpike, and Hood [7] studied 20 cases of neurofibroma of the acoustic nerve and other varieties of space-occupying lesions of the cerebellopontile angle. Recruitment was absent in 14 cases and present but incomplete in 6 cases. Eby and Williams [9] studied 16 cases of deafness due to involvement of the acoustic nerve. Recruitment was absent in 13 cases and incomplete in 3 cases. Diplacusis binauralis dysharmonica was present in one case. Speech intelligibility increased with increase of intensity within the limits of the audiometer in five of six patients so tested. Threshold of discomfort was not found within the limits of the audiometer in any case.

Mygind [1] observed that "humoral" deafness may be present in cases of acoustic neurofibroma owing to the effect of venous stasis. Fowler [21] reported two cases of acoustic neurofibroma in which complete recruitment was found. Dix and Hood [10] reported recruitment present in 5 of 72 cases of acoustic neuroma. They attributed the phenomenon to hair-cell changes owing to occlusion of the cochlear vascular supply. Two patients were cited in whom a very small neuroma was removed, leaving the eighth nerve intact. Hearing threshold was unchanged but recruitment was absent after operation. One such patient has been observed at the Mayo Clinic.

CONCLUSIONS

Deafness due to dysfunction of the cochlea may be differentiated from deafness due to lesions of the acoustic nerve with a considerable degree of accuracy. End-organ deafness is most commonly observed in Ménière's disease but is absent during two phases of the disease. These are remissions during which hearing becomes normal, and in the late stages of the disease when it is assumed that nerve cells in the spiral ganglion have degenerated. Approximately 20% of cases of Ménière's disease do not exhibit end-organ deafness. End-organ deafness is characteristically absent in cases of lesions involving the acoustic nerve but may be present during early stages of acoustic neurofibroma when pressure of the tumor causes greater disturbance of circulation than of nerve function. Recruitment of loudness was demonstrated in 8% of cases of acoustic nerve lesions by Dix and Hood.[10]

The presence or absence of end-organ deafness does not provide unqualified differentiation between Ménière's disease and lesions of the acoustic nerve. Studies of hearing do provide objective evidence in support of diagnostic information gained from the history and from the examination. In this sense the diagnosis of end-organ deafness is a valuable clinical tool.

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A Clinical Method for Calibrating the Bone-Conduction Audiometer

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The clinician who wishes to make full use of pure-tone audiograms needs a valid and simple method for ensuring that the calibration for his bone-conduction system is adequate. Unfortunately, we lack a standard procedure whereby the physicist can specify for us the vibrational output representing bone-conduction norms.* For the time being the clinician must therefore rely upon his own efforts to assure himself that his bone measurements are acceptable. Even after a physical standard is established, the need will remain for an easy and adequate method of checking calibration in a clinical situation.

There are three calibrational methods from which the clinician can choose. The first method utilizes loudness balancing, the second is based on thresholds yielded by normal listeners, while the third relies on the responses of cases with sensorineural (or nerve-type) loss.

The loudness-balance method is advocated by Beranek as a means of transferring air-conduction norms to a bone-conduction system. However, the technique possesses three practical disadvantages. First, the equipment necessary for loudness matching is not available in all clinical situations. Second, recent studies of "on-effect" and "adaptation" † clearly imply that very insightful control of the conditions must be maintained for loudness balances to be valid. Lastly, the matching of a bone-conduction sound to the loudness of a monaural air-borne stimulus will be in error because the bone-conduction stimulus will reach both ears unless the contralateral ear is effectively masked.[5] Consequently, insofar as the clinical situation is concerned, there is need for a simpler yet valid procedure.

A second approach is to establish the reference values for a bone-conduction system by averaging the bone thresholds exhibited by subjects with normal hearing.‡ This approach has high face validity, and it has been widely accepted. It is, for example, the method which was specified in the American Medical Association requirements for a diagnostic pure-tone audiometer.[7] These requirements define the reference threshold, at each test frequency, as the "hearing loss setting of the audiometer" representing the average of the bone thresholds obtained on six subjects with normal acuity. Only measurements on unoccluded ears are to be considered, and all tests are to be conducted ". . . in a room free from extraneous sound of sufficient intensity to vitiate the measurements."[7] Unfortunately, there are numerous clinical situations where this last requirement cannot be easily met. Many audiometric rooms which are adequate

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Based on a portion of a doctoral dissertation from the School of Speech and the Department of Otolaryngology of Northwestern University.

* References 1 and 2.

† References 3 and 4.

‡ Some workers prefer computing the reference values from medians or modes rather than from means (Harris[6]). The distinction probably has more theoretical than clinical importance.

for testing normal listeners when they have the extra protection of ear cushions possess ambient noise which is intense enough to mask these same persons when their ears are unoccluded. In other words, a room may be fully usable for air-conduction audiometry without being quiet enough to yield uncontaminated measures of normal threshold for bone. In practice, this fact means that the wise clinician will not attempt to calibrate his bone-conduction system on normal ears unless he is certain the noise level in his testing room is so low it will not influence his subjects.

The third method, which utilizes the responses of persons with hearing loss, was described by Carhart as a means of escaping the influences of unavoidable room noise.[6] The method allows the clinician to take advantage of two facts. First, a moderate hearing loss offers protection against the masking effect of mild ambient noise. Second, persons with pure sensorineural loss possess the same impairment whether tested by air or by bone. The procedure involves obtaining both air- and bone-conduction thresholds, in a reasonably quiet room, on a group of ears with impairments of the sensorineural variety. The responses at each test frequency are averaged separately for air and for bone. The clinician must have assured himself in advance that his air-conduction system is in acceptable calibration. This being the case, substantial discrepancies between the two sets of averages represent the corrections required to bring the bone system into calibration. It is a simple matter, once this information is available, to apply these corrections in subsequent clinical testing. Audiometric curves incorporating these corrections should show the proper relation between a patient's loss by bone and the normal reference line on the audiogram chart.

While Carhart's method appears theoretically sound and it is adaptable to most situations, we still need to assure ourselves through appropriate experimentation that it can yield a valid reference level for bone-conduction audiometry. Here, the obvious test of validity is whether normal ears exhibit the anticipated threshold readings for bone when tested with a system calibrated on ears with sensorineural involvement. Validatory measurements must, of course, be made in an environment sufficiently quiet to avoid danger of any masking when testing by either modality. If, under these circumstances, the normal group's average audiogram for air agrees with its average audiogram for bone, Carhart's method will have been shown to be capable of yielding a valid "zero loss" level from which to estimate hearing acuity by bone conduction.§ In other words, the final criterion for validity of a threshold reference level is that persons without hearing loss shall obtain thresholds which are labeled as normal when they are tested with the system under scrutiny.

The degree to which Carhart's proposal can satisfy this criterion was explored experimentally with a commercial audiometer. The adequacy of this instrument's air-conduction system was first assured through appropriate electroacoustic measurements. Next, a corrected calibration for its bone-conduction system was computed from the responses of 23 ears having sensorineural, or nerve-type, impairments. Thirdly, thresholds for air and bone were obtained on 127 normal ears. Finally, these data were examined statistically to ascertain the adequacy of the corrected calibration assigned to the bone-conduction system.

APPARATUS

The audiometer selected was a Maico E-2.‖ To simplify procedures, only one of the instrument's two channels was employed throughout the study. Both the air- and the bone-conduction receivers were activated through this channel. The air-conduction

§ Even if the method is demonstrated to be valid in the sense that it brings the two systems into calibrational agreement, we must remember that the adequacy achieved in a given clinical situation will depend upon the accuracy with which the air-conduction system has been calibrated.

‖ The Maico Company made this instrument available.

receiver was a Permoflux PDR-10, in a Maico cushion. The bone-conduction receiver was of the hearing-aid variety.¶

The physical performance of the audiometer was assessed carefully.# The instrument satisfied the requirements for a diagnostic audiometer.[7] Test frequencies were within appropriate limits of accuracy. The attenuation system was acceptably linear. Harmonic distortion was adequately controlled. The instrument was suitably free from internal noise, and its bone oscillator did not produce excess sound radiation by air.

The acoustic output of the air-conduction system was measured, in a 6 cc. coupler of the 9A type, with a 640AA microphone. The sound pressure levels for the "zero hearing loss" settings of the audiometer were found to be within 3 db. of the correct value for the earphone involved, except for a discrepancy of 4.6 db. at 8000 cps. These values are within the limits designated for commercial audiometers.[10] On this basis we can state that the air-conduction system employed in the present study was correctly calibrated within the accuracy required for clinical audiometry.

The vibrational output of the bone-conduction oscillator was investigated, in relative terms, with an artificial mastoid.* The performance of the bone-conduction channel proved quite satisfactory except for some excess harmonic distortion at high output levels for 250 cps.

Special precautions were taken to assure that the audiometer remained stable throughout the entire time span of the study. These precautions involved daily measurement of the acoustic and vibrational outputs of the air and bone channels, respectively. Analysis of these measurements revealed excellent stability in physical performance.

EMPIRICAL CALIBRATION OF THE BONE-CONDUCTION SYSTEM

In order to obtain a group on which to establish an empirical calibration of the bone-conduction system, 23 persons with pure sensorineural losses of intermediate severity were chosen from the case files of the Northwestern University Hearing Clinic. All these persons had been diagnosed by staff otologists as having pure sensorineural (or nerve-type) hearing losses. There were 5 cases of presbycusis, 2 of labyrinthine hydrops, 2 with congenital impairments, and 14 due to miscellaneous or unknown causes. No attempt was made to control the sex or age distribution of the group. The group included 12 men and 11 women. The age range was from 17 to 77 years, with an average age of 50.7 years.

Each subject was given an audiometric test by both air and bone in a room with superior acoustic characteristics. The ascending method, as advocated by Hughson and Westlake,[11] was employed. Only the data for each subject's better ear were used. Consequently, masking was not employed. To obtain bone measurements the oscillator was first positioned at the point on the mastoid yielding maximum sensitivity with 1000 cps as the stimulus. Thresholds for all frequencies were then determined without shifting the bone unit. Subjects were closely questioned to ascertain whether the sensation was contralateralized. Properly ipsilateralized threshold responses for bone were obtained from 23 subjects at 250 cps, 18 at 500 cps, 21 at 1000 cps, 18 at 1500 cps, 16 at 2000 cps, 13 at 3000 cps, and 19 at 4000 cps. These responses, and their comparison responses for air conduction, constitute the data from which the empirical calibration of the bone system was compiled.

Table 1 summarizes, in the form of means for the group, the results at each frequency. The table also reports the difference, or discrepancy, at a given frequency between the mean for air thresholds and the mean

¶ This bone oscillator was incorporated in the audiometer at our request. So far as we know, the Maico Company has never advocated using this type of receiver with its E-2 audiometer. Therefore, the results we report here do not indicate the performance of the instrument when equipped with the larger bone receiver, which is the standard accessory for the E-2.

Details are reported in Roach.[9]

* The Sonotone Corporation supplied detailed plans for this unit.

for bone thresholds. These discrepancies, according to Carhart's premise, represent the approximate corrections required to equate the air- and bone-conduction systems.

Higher hearing-loss dial readings were required to reach bone-conduction thresholds than to reach air-conduction thresholds at all frequencies except 4000 cps. This fact indicates that, at a given dial reading, the bone-conduction system produced a weaker stimulus in the inner ear than did the air-conduction system at the same frequency. Since, in the present instance, the air-conduction system was found to be in satisfactory calibration, the various discrepancies were judged to reveal the amounts by which bone-conduction reading obtained with this particular audiometer should be reduced in order to yield true indications of the thresholds they represent. In other words, corrected thresholds, estimated to the nearest 5 db., should be computed by subtracting the following values from the hearing-loss dial readings when testing by bone:

TABLE 1.—*Mean Audiometric Settings Representing the Air-Conduction and the Bone-Conduction Thresholds of Twenty-Three Ears with Sensorineural Impairment (Expressed in Decibels re the Zero Setting of the Hearing-Loss Dial)*

Frequency	Air	Bone	Difference Between Settings
250	18.7	37.2	23.5
500	20.3	46.1	25.8
1000	39.0	41.9	2.9
1500	44.7	49.2	4.5
2000	43.4	49.7	6.3
3000	42.4	50.0	7.6
4000	42.9	43.2	0.3

25 db. at 250 cps
25 db. at 500 cps
5 db. at 1000 cps
5 db. at 1500 cps
5 db. at 2000 cps
10 db. at 3000 cps
None at 4000 cps

Stated differently, these corrections represent the establishment of empirically revised norms for measuring bone-conduction acuity with the audiometer under study.

VALIDATORY TEST OF EMPIRICAL CALIBRATION

The question which interests us now is whether corrections established by the method just outlined are valid in the sense that they yield the same base of reference as would have been computed directly from the bone-conduction responses of normal ears. This question is easily attacked. One must first administer pure-tone tests to a group of subjects known to have normal hearing. One must then compare the estimate of the group's acuity by air with its apparent acuity by bone. Provided the two estimates of acuity are in close agreement, the bone system may be said to have essentially the same base of reference as the air-conduction system.

In the present instance, 127 college undergraduates constituted the group of normal listeners employed to make this test.† The age range of the group was from 17 to 27 years, with the mean age being 18.5 years. The group included 44 men and 83 women.

This phase of the study required a testing room so quiet that its ambient noise would not mask unoccluded normal ears. The room used had a noise level of less than 24 db. when measured with a sound-level meter set to the A scale.

Thresholds for both air and bone were again determined by the ascending method. It had been decided to use data on only one ear per subject. Selection of this ear was random except in those instances where the bone-conduction stimulus appeared to the subject to be contralateralized.‡ When this occurred, the data for the other ear were used unless contralateralization was also evident here, in which event the subject was discarded. The 127 subjects whose thresholds were analyzed each had an ear satisfying this criterion.

† These cases satisfied Beasley's criterion for normal hearing by air conduction, except for a few subjects with mild high-frequency losses (Beasley [12]).

‡ Masking of the opposite ear was not employed, since Cochran has demonstrated that even a mild noise in one ear may change appreciably the threshold of the other ear (Cochran [13]).

The threshold responses for air conduction were recorded without modification, but audiometric readings were corrected by the values mentioned earlier, in order to obtain the estimated thresholds for bone.§ The criterion by which the validity of the empirical calibration of the bone system was judged was the agreement to be found between the air-conduction thresholds of the 127 normal ears under study and the corrected measures of their bone-conduction acuity.

Table 2 summarizes group means for air and for bone. All group means for air conduction are negative. This fact indicates that the 127 ears under study were, as a group, slightly hyperacute relative to the "average normal threshold." This result is exactly what would be expected in testing a large group of young college students, and it is consistent with other investigations of undergraduates at Northwestern University.

TABLE 2.—*Mean Acuity for the Better Ear Exhibited by 127 University Students (Expressed as Decibels of Hearing Loss re the Corrected Audiometric Normal)*

Frequency	Air Mean	Bone Mean	Difference*	*t*-Ratio†
250	−7.3	−5.5	−1.8	5.43
500	−5.9	−6.9	1.0	3.49
1000	−4.8	−5.9	1.1	3.59
1500	−4.9	−6.4	1.5	3.90
2000	−3.9	−3.5	−0.4	1.04
3000	−3.9	−4.5	0.6	1.38
4000	−6.7	−4.2	−2.5	6.08

* A negative difference indicates poorer bone-conduction threshold.
† *t*-Ratio of 1.98 and 2.62 significant, respectively, at 5% and 1% levels.

Group means for bone conduction were also negative to approximately the same degree. As is summarized in Table 2, the discrepancy between the means for air and bone conduction is 1.5 db. or less for five of the seven test frequencies. The differences which exceeded 1.5 db. were 1.8 db. at 250 cps and 2.5 db. at 4000 cps. Even these two latter discrepancies are small enough to be of little importance to the clinician. Moreover, the means for air conduction are not consistently higher or lower than the means for bone.

Despite the fact that the discrepancies just mentioned are too small to have much clinical meaning, most of them were statistically significant. Specifically, five of the seven *t*-ratios reported in Table 2 substantially exceed the 1% level of confidence. One may conclude that the discrepancies are a result of a minor yet real margin of uncertainty arising because correction values could be assigned to the bone-conduction system only to the nearest 5 db. interval. For this reason alone, any single correction might deviate by as much as 2.5 db. from the proper value. Fortunately, a systematic calibrational deviation of 2.5 db. or less does not destroy the clinical meaning of a bone-conduction measurement.

In the present instance, there is absolutely no evidence that the method employed for calibrating the bone-conduction system yielded a false base of references. The audiometer labeled normal ears as having, in the aggregate, the bone-conduction acuity which their measured acuity for air conduction required. Thus, calibration of the bone-conduction system on the basis of responses by patients with sensorineural loss has here been demonstrated to yield reference values which are clinically equivalent to those which would have been obtained had the calibration been based on the responses of normal ears.

Further confirmation of the general adequacy of the bone-conduction measurements obtained on the 127 normal ears is found in (1) comparison of population variability for the two stimulus modalities and (2) correlation between the air- and bone-conduction thresholds.

§ Actually, data from two complete tests on each subject were available. These tests, spaced about a month apart, were administered to gather information on the test-retest reliability of pure-tone audiometry. It was felt that, for present purposes, the average of a subject's two responses for a given test condition would give an improved indication of the subject's acuity. The discussion which follows is based on such an averaging of the test-retest data.

As regards population variability, the two modalities yielded threshold data which were very similar in range and distribution. This fact is illustrated in Table 3.

It is particularly instructive to observe the differences between the standard deviations for air and bone which are reported in the sixth column of the table.‖ These differences are all numerically small and do not represent a clinically important distinction in the variability of air- and bone-conduction results for the 127 normal ears under consideration.

The correlation between the air- and bone-conduction thresholds exhibited by individual subjects was found to be very good, as can be seen by noting the product-moment coefficients reported in Table 4. The coefficients range between +0.48 and +0.76. Coefficients of this magnitude indicate a high interdependence, since they were derived from data on normal ears which encompassed relatively narrow ranges. Theoretically, such interdependence should exist if the testing environment and the testing procedures are adequate. Its manifestation in the present instance adds greatly to the confidence we may have in both the air- and bone-conduction measurements obtained on the 127 normal ears. We therefore accept these measurements with greater surety as a means of confirming the adequacy of Carhart's empirical method for establishing the zero reference level for a bone-conduction system.

TABLE 3.—*Ranges and Standard Deviations of Thresholds for Air Conduction and for Bone Conduction Exhibited by 127 Normal Ears, Expressed in Decibels*

	Range		Standard Deviation		
Frequency	Air	Bone	Air	Bone	Difference*
250	17.5	15.0	3.3	3.9	0.6
500	15.0	17.5	3.8	3.5	0.3
1000	17.5	17.5	3.9	4.4	−0.5
1500	22.5	15.0	4.7	4.6	0.1
2000	20.0	20.0	5.2	5.9	−0.7
3000	42.5	37.5	7.0	6.3	0.7
4000	25.0	30.0	5.1	5.6	−0.5

* A negative difference indicates that the S. D. for bone is greater than the S. D. for air.

‖ The standard deviations were found to be progressively larger as the test frequency became higher. This trend is common to both the air- and the bone-conduction data. It merely indicates that the population of "normal" ears under study possessed greater variability in acuity for higher-pitched tones.

TABLE 4.—*Coefficients of Correlation Between the Thresholds for Air Conduction and the Corrected Thresholds for Bone Conduction*

Frequency	Product-Moment r
250	0.48
500	0.57
1000	0.65
1500	0.59
2000	0.60
3000	0.76
4000	0.64

COMMENT

It has often been emphasized that the median is a more accurate statement of the central tendency of data involving decibel values than the mean.[14] Hence, if the primary interest in the present study had been to express the numerical values of the central tendencies with the greatest precision, medians should have been used. However, the main concern in the present instance was with the discrepancy between the central tendencies in the air- and bone-conduction measures obtained on the 23 cases with sensorineural loss. There is no reason to believe that the span between these central tendencies would have been more accurately expressed by considering medians than means. The same argument applies when comparing the threshold data yielded by the 127 normals. Hence, since tests of statistical significance are more easily applied when means are employed, the latter were chosen as the basis for the analysis reported above.

The propriety of this decision can be easily checked by ascertaining what differences would have resulted had the interpretation been based on medians.

Table 5 presents the median audiometric settings for the 23 cases of sensorineural loss and reports the discrepancies between their corresponding air- and bone-conduction

TABLE 5.—*Median Audiometric Settings Representing the Air-Conduction and Bone-Conduction Thresholds of Twenty-Three Ears with Sensorineural Impairments (Expressed in Decibels re the Zero Setting of the Hearing-Loss Dial)*

Frequency	Air	Bone	Difference Between Settings
250	15.0	41.3	26.3
500	20.0	45.8	25.8
1000	38.7	41.2	2.5
1500	45.0	52.5	7.5
2000	46.3	53.8	7.5
3000	47.8	51.8	4.0
4000	46.3	44.4	—1.9

medians. Assuming that no correction in the reference for the bone system is necessary until the difference exceeds 2.5 db., the pattern of correction called for by Table 5 becomes 25 db. at 250 and 500 cps; no correction at 1000 cps; 5 db. at 1500, 2000, and 3000 cps; nothing at 4000 cps. These corrections are the same as those derived from consideration of means except at 1000 and 3000 cps, where in each instance the correction based on medians is 5 db. less than the one based on means.

These two disagreements, while not large, do raise the question as to which criterion of central tendency in this instance yielded the superior calibration. One method of examining this question is to compute the calibrations which would have been assigned to the bone system if it had been derived from the responses of the 127 normal ears. In this instance the discrepancy between the actual audiometric settings yielding air and bone thresholds of the normal group indicates the magnitude of the correction required by the bone-conduction system. This discrepancy was computed, for each test frequency separately, from the median audiometer readings for the 127 normal ears and, independently, from the mean audiometric readings. The results are reported in Table 6. If calibration of the bone conduction had been based on these data, the correction factors reported in Table 7 would have applied. Here, too, corrections are in 5 db. steps and differences of 2.5 db. or less have been disregarded. For purposes of comparison the corrections derived from the responses of the 23 cases of sensorineural are also reported in Table 7. A "best estimate" is also reported. This estimate is the correction most often called for at each test frequency.

Two generalizations are quickly apparent from Table 7.

First, there appears to have been a real discrepancy in the correction required by the two populations at 1500 cps. The normal group showed such close agreement between the median scores for air and bone, as well as between mean scores, that no correction appears necessary. Both sets of statistics for the hard of hearing population suggest the bone system is 5 db. weak. If one accepts the responses of the normals as the criterion of validity, then the calibration of the bone system based on responses of impaired ears proved at 1500 cycles to be 5 db. in error. Such a finding should serve as a warning to the clinician, since it indicates that errors can occur even when calibration of a bone system is based on carefully selected cases of sensorineural loss. Equally important, however, is the fact that only one such error was here observed and that it had

TABLE 6.—*Discrepancies Between the Central Tendencies of the Uncorrected Settings of the Hearing-Loss Dial (Raw Scores) for Air and Bone Conduction Representing Threshold Responses of 127 Normal Ears*

Frequency	Group Median			Group Mean		
	Air	Bone	Difference	Air	Bone	Difference
250	—8.4	18.7	27.1	—7.3	19.1	26.4
500	—6.2	17.1	23.3	—5.9	17.3	23.2
1000	—5.0	—2.0	3.0	—4.8	—1.6	3.2
1500	—5.4	—4.2	0.8	—4.9	—3.3	1.6
2000	—4.9	—0.1	4.8	—3.9	1.1	5.0
3000	—5.3	—3.0	8.3	—3.9	4.7	8.6
4000	—8.7	—5.0	3.7	—6.7	—4.2	2.5

a magnitude of only 5 db. We may retain the conclusion that a bone system can be empirically calibrated on sensorineural losses to a precision which has reasonable clinical accuracy.

Second, the corrections derived from comparison of means, whether for normals or for hard of hearing subjects, are the more defensible in the present study. It would be hazardous to presume that this situation would always apply, but in the present instance the two sets of corrections based on means were in perfect agreement at all test frequencies except 1500 cps. Concomitantly, at least one of the estimates derived from the comparison of medians was in agreement with the two estimates from means. On the other hand, if either set of medians is used as the basis for calibrating the bone system, the median response of the other population is in disagreement by one correction step (5 db.) at four of the seven test frequencies.

TABLE 7.—*The Summary of Corrections in the Calibration of Bone-Conduction System Required by Various Estimates of Central Tendency*

	Normal Ears		Impaired Ears		
Frequency	Median	Mean	Median	Mean	Best Estimate
250	25	25	25	25	25
500	25	25	25	25	25
1000	5	5	0	5	5
1500	0	0	5	5	0 or 5
2000	5	5	5	5	5
3000	10	10	5	10	10
4000	5	0	0	0	0

SUMMARY

The present study was undertaken to determine if it is possible to establish a clinically acceptable reference level for bone-conduction audiometry by comparing air- and bone-conduction responses yielded by subjects with sensorineural loss. The study has demonstrated that a clinically acceptable reference level can be achieved in this manner. A commercial audiometer whose air-conduction system met current standards for adequate calibration and performance was used. Standard audiometric tests by air and bone conduction were then administered to 23 cases diagnosed as having pure sensorineural loss. The corrections required by the bone-conduction system of the audiometer were computed to the nearest 5 db. These corrections were based on the premise that, since the air-conduction system was in calibration, any sizable discrepancy between the group's apparent acuity level by air and bone was due to incorrect calibration of the bone-conduction system.

The adequacy of these corrections was subsequently confirmed by testing 127 normal listeners in a sound-proof chamber of research caliber. Had the original calibration been based on the performance of these normal listeners, exactly the same corrections would have been obtained except at 1500 cps. Even at 1500 cps, the error in the calibration based on sensorineural losses was only 5 db.

Thus a useful set of reference values for the bone-conduction system was here achieved with an empirical procedure utilizing the responses of selected cases with hearing loss. The procedure offers the otologist, the audiologist, and the audiometrician a method for achieving a reasonable calibration of his bone-conduction system which is free from the pitfalls which plague the clinician when he tries to calibrate his bone system on normal listeners in the usual office environment.

School of Speech, Northwestern University (Dr. Carhart).

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News and Comment

ANNOUNCEMENTS

Hearing Society Opens Scholarship Competition.—The American Hearing Society announces that competition for the 1956 Kenfield Memorial Scholarship will open March 1. Such an award is made annually by the Society to a prospective teacher of lipreading.

Application blanks may be obtained by writing to the Society's national headquarters, 1800 H St., N.W., Washington 6, D. C. Deadline for returning completed applications is May 1. The scholarship winner will be selected by the Teachers Committee of the American Hearing Society, of which Miss Ruth Bartlett, Los Angeles, is chairman.

Award of the 1956 scholarship is to be made during the 37th Annual Meeting of the American Hearing Society in Washington, June 7-9.

Funds for the Kenfield Memorial Scholarship were subscribed in 1937 in memory of Miss Coralie N. Kenfield, San Francisco, who was nationally known for her advanced methods in teaching lipreading to the hard of hearing.

Winner of the annual award is entitled to take a teacher training course in lipreading from any school or university in the United States acceptable to the Teachers Committee. The scholarship is to be used within one year from the date of award.

A satisfactory applicant for the scholarship must be a well-adjusted individual with a pleasing personality, legible lips, good speech and voice, and no unpleasant mannerisms. Graduation from college with a major in education, psychology and/or speech is a requirement.

Specifications for a hard of hearing contestant include 30 clock hours of private instruction in lipreading from an approved teacher or 60 hours of lipreading in public school classes under an approved teacher. Rules for competition state that an applicant shall plan to teach lipreading with or without other types of speech or hearing therapy.

Winner of the 1955 Kenfield award was Mrs. Tessie O. Shirley, Brownwood, Texas.

Audiologic Aspects of Audiosurgery

MOE BERGMAN, Ed.D., New York

In recent years two major approaches have emerged for the relief of the handicap of deafness—auditory rehabilitation and audiosurgery.* The early part of the 20th century saw the first organized efforts to develop compensatory skills for the communication handicap which divided the person with impaired hearing from his fellow man. Leagues for the hard of hearing and some universities developed systems for teaching lipreading and offered help in the eradication of voice and speech changes resulting from the defective hearing. In the 1940's the electronic hearing aid gained maturity and its acceptance on an increasingly large scale was assured. During and after World War II the Army and Navy aural rehabilitation programs brought a fresh emphasis on the team approach to deafness and stimulated the development of the science of audiology.

At about the same time the surgical treatment of middle-ear deafness, abandoned some years before, commanded renewed interest, particularly with the ultimate refinement of the fenestration operation by Dr. Julius Lempert. A growing number of patients with otosclerosis enjoyed restoration of hearing great enough to function part or all of the time without hearing aids.

More recently, the development by Dr. Samuel Rosen of a new technique for restoring hearing without violating the anatomy of the ear has extended the possibilities of rehabilitation to many more persons with otosclerotic deafness.

In terms of the rehabilitation of deafness, a patient will henceforth have the advantage of at least three courses of treatment. First will be the attempt to restore bilateral normal hearing through the application of recognized medical procedures in the otologist's office and through surgical techniques. Normal hearing means acuity within 10 db. of the pure-tone or speech audiometric reference of "zero hearing loss." Clinical experience has shown that this goal is attainable through stapes surgery in certain cases of otosclerosis. Secondly, for those patients for whom surgical intervention is not indicated, rehabilitation in an audiology center can be prescribed, to include the selection of a hearing aid, instruction in lipreading, speech correction, auditory training, and counseling. Finally, for the large number of patients with middle-ear deafness complicated by changes in the inner ear, treatment can be designed to combine surgery and auditory rehabilitation.

The patient who is recommended for audiosurgery will benefit from the close cooperation of the surgeon and the audiologist in the selection of cases and follow-up. Together the surgeon and the audiologist can evaluate the preoperative hearing function in all its aspects, predict the amount and kind of hearing gain which can be obtained from successful surgery, and determine the goal of the operation for each patient. Rosen and Bergman have suggested a set of goals for stapes mobilization.[2]

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* The term "audiosurgery" was suggested by Antolí-Candela and co-workers.[1]

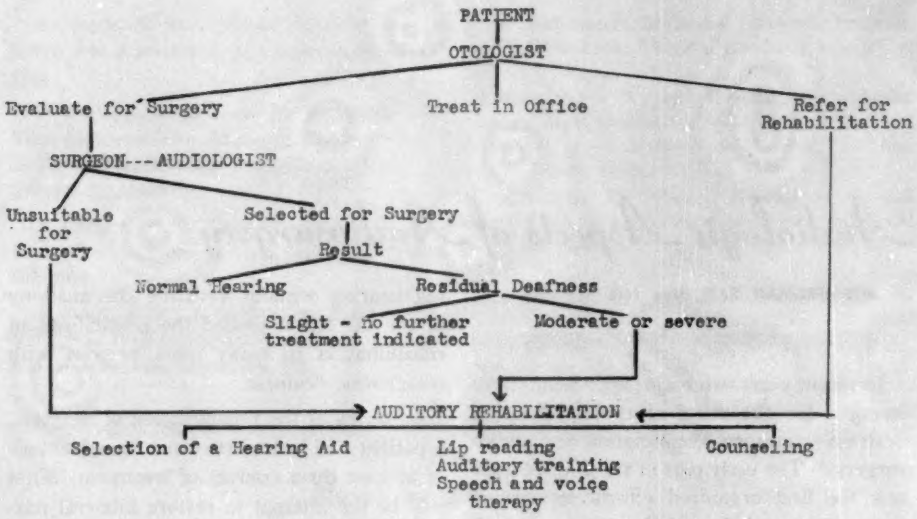

Fig. 1.—Procedure for processing a patient with impairment of hearing.

The present paper is concerned with the management of patients referred for audio-surgery, particularly mobilization of the stapes.

THE EVALUATION OF HEARING FOR MOBILIZATION

The assessment of hearing function prior to surgery should be intensive and extensive. Intensity implies a thorough quantitative investigation of each aspect of hearing tested, with all test instruments properly calibrated and the tests administered by highly trained and experienced personnel. Since this surgery is elective and has as its main purpose the improvement of hearing, the accuracy of the preoperative and postoperative testing and the thoroughness with which the patient's total problem of deafness is managed must receive the same attention as the specialized surgical skill which is required to perform this operation successfully. There no longer seems to be justification for handicapping the surgery with a test which is not valid or reliable. Because of the limitations of tests currently in use it is necessary frequently to employ a variety of tests, to reduce doubts about the suitability of a patient for the operation and to develop realistic goals for the treatment.

Routine Hearing Evaluation

Preoperative and postoperative tests should include pure-tone threshold audiometry, by both air conduction and bone conduction, and the speech reception threshold and speech discrimination score as a minimum battery. Additional procedures which provide pertinent information are the Weber test, a quantitative Gellé, and a tolerance test, using speech of high intensity. The latter procedure may provide a valuable diagnostic differentiation of otosclerotic deafness and deafness due to otitis media, if current investigations along this line continue to substantiate clinical observations.

Testing for Cochlear Reserve

One of the more disturbing aspects of pure-tone testing is the difficulty in determining which ear is responding to bone-conduction signals. Fortunately, many of the cases considered for operation have deafness which is similar in type and severity in the two ears. In other cases, where the surgeon must decide about operating upon a patient in whom the hearing by air conduction is significantly different in the two ears, the bone-conduction threshold of each ear must be clearly delineated. Here the use

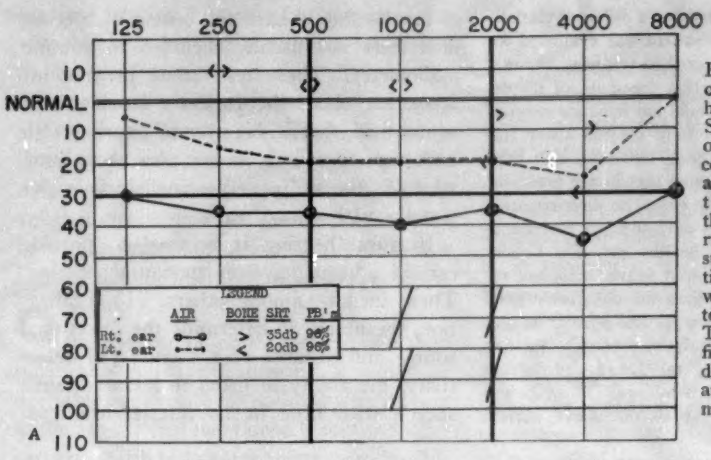

Fig. 2A (Case 1).—Preoperative audiogram of a patient with unequal hearing in the two ears. Since stapes mobilization of the right ear was under consideration to effect binauralization of hearing, the bone-conduction thresholds, Fowler binaural loudness balance results, and the discrimination score of the right ear were essential to the determination of suitability. These tests added confirmation to the clinical diagnosis of otosclerosis, and the right stapes was mobilized in April, 1955.

of masking seems inescapable and the patient must be required to indicate which ear hears each test tone presented by the bone receiver. In spite of such precautions there still is a margin of error in relating the bone thresholds obtained for each ear with the cochlear hearing of the same ear. Clinicians have often noted, for example, that patients with total loss of hearing in an ear may refer bone-conduction signals to that ear rather than to the ear which has hearing. In cases where there is a doubt about the bone-conduction findings the decision to operate may be based upon the speech discrimination score, the presence or absence of recruitment (as investigated by the Fowler binaural loudness balance and Reger monaural loudness contour techniques), difference limens (using the Lüscher or the Jerger method), tolerance thresholds, and other tests which evaluate cochlear function. The following two cases illustrate the use of such tests in the selection of cases for surgery.

CASE 1.—A 41-year-old woman. The pure-tone audiogram showed a preoperative picture in which the left ear heard better than the right ear by air conduction but the bone threshold for the right ear was better than for the left ear at 2000 and 4000 cps. The discrimination score for the right ear was within normal range, and the Fowler loudness balance test showed normal loudness function for the right ear. The patient's right stapes was mobilized in April, 1955, with the results shown in Figure 2B.

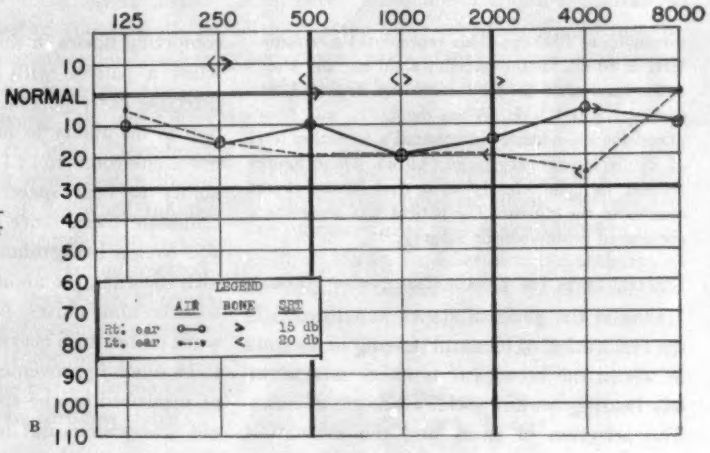

Fig. 2B (Case 1). — Postoperative results after three months.

CASE 2.—This case presented a different clinical-audiological picture. The patient was evaluated for surgery with the possible goal of restoring binaural hearing. The bone-conduction threshold of his defective left ear seemed to hold out hope for surgical restoration of hearing, if only for the lower frequencies. Additional testing, however, left little doubt that the primary lesion was in the inner ear rather than in the middle ear. The discrimination score for the left ear was only 46%, in contrast to the score of 96% in the healthy ear. The Fowler loudness balance test showed nearly complete recruitment at 500 cps, despite the apparently good hearing by bone conduction for the left ear at that frequency. At 1000 cps and above recruitment was complete. A variation of the Lüscher difference limen test was performed as follows. The D. L. was measured for each ear at 80 db. above normal threshold, at 1000 cps. This represented a sensation level of 80 db. for the patient's right ear and a sensation level of 25 db. for the left ear. The D. L. for each ear was 0.5 db. When the D. L. was determined for the normal right ear at a sensation level of 25 db. it was very large: 4.0 db. These figures seemed to point clearly to a dysfunction of the cochlea of the left ear. The patient was accordingly considered unsuitable for surgery.

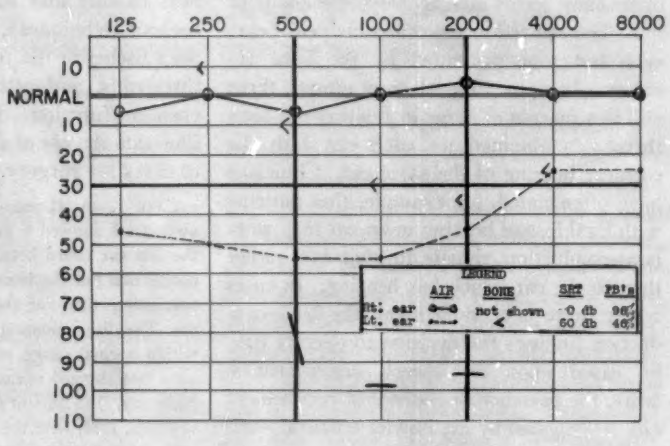

Fig. 3 (Case 2).—The bone-conduction measurements of the defective left ear seemed to indicate a mixed type of deafness. Additional testing did not support this diagnosis. The speech discrimination score of 46% must be associated with a significant inner-ear lesion. This is further corroborated by the Fowler binaural loudness balance results and the difference limens obtained. At an audiometric level of 80 db., which was a sensation level of 80 db. for the right ear and 25 db. for the left ear, the D. L. for each ear at 1000 cps was 0.5 db. As a further check on the patients D. L. function the right ear was measured at its sensation level of 25 db. This time the D. L. for the good ear was 4.0 db. The finding of a D. L. of 0.5 db. for the left ear was therefore considered significant.

SPECIAL TESTS FOR BINAURALIZATION OF HEARING

One of the goals of stapes mobilization is the restoration of binaural hearing in patients in whom the better ear is either normal or has hearing within socially adequate limits. The selection of cases and the evaluation of results should have the benefit of specialized tests not usually included in routine audiometry. These tests must provide information about the patient's hearing in a sound field, that is, his over-all hearing with both ears to sounds in the area about him, which is the ordinary hearing situation for persons with normal ears.

Binaural hearing is believed to provide certain advantages over monaural hearing. These include, among others, (1) localization, the ability to determine the directional source and distance of a sound; (2) selectivity, the ability to listen to a conversant's speech with little or no interference from competing noises in the area (this is implied when a patient with one normal and one defective ear reports a distressing deterioration in his ability to understand speech in a noisy environment); (3) discrimination, the ability to hear speech sounds and to discriminate them more clearly, both in quiet and over a background of noise; (4) sound identification, the ability to identify common sounds and noises better. From Hirsh's work on binaural hearing there does not seem to be much improvement in acuity of hearing as measured by the speech reception threshold when monaural hearing is replaced by

binaural hearing.[3] It may be, however, that with binaural hearing it requires less effort to hear than with only one ear. This can be demonstrated simply by alternately closing and releasing the tragus of one ear while listening to soft speech. It is apparent also when a patient who wears binaural hearing aids removes one from his ear. Invariably he will increase the volume of the remaining hearing aid considerably to achieve comparable hearing.

If the purpose of stapes mobilization is to binauralize a patient's hearing, it would be desirable to measure his abilities with respect to the aspects just mentioned before and after surgery. Such tests are perhaps more feasible in the audiology clinic than in the average private office but are relatively simple to conduct if some inexpensive equipment is added to the main testing assembly. The following procedures are suggested: 1. A measure of localization ability can be accomplished through the use of between four and six low-cost loudspeakers placed on each of the four walls of the test chamber and, possibly, also on the floor and ceiling. All speakers are controlled from a switch box with four to six push buttons. 2. Selectivity can be investigated by obtaining a threshold for relatively familiar material, such as the spondee words, presented through a loudspeaker, while either noise of a general character or white noise is presented simultaneously at a constant level of about 70 db. re 0.0002 microbar from another loudspeaker, placed 180 degrees away from the first. 3. Discrimination tests, using PB word lists, can be performed in the usual "free-field" manner for the test in quiet and with the two-speaker system just described for the test in noise. 4. Sound identification testing can be accomplished by presenting approximately 10-50 common sounds and noises prior to surgery, noting the number correctly recognized and then, if the operative goal is attained, repeating the test when the hearing in the ear operated on becomes stable.

Special Tests for Patients with Profound Mixed Deafness

It has been shown by Rosen and Bergman that the successful mobilization of the fixed stapes in profound deafness due to otosclerosis and secondary nerve degeneration can improve significantly a patient's potentialities for auditory rehabilitation.† Quantitative evaluation of such a result can be secured if, in addition to the tests previously mentioned, the patient's hearing with a hearing aid is quantified preoperatively and postoperatively. Two free-field measurements are suggested. First, the speech reception threshold should be obtained with one or more hearing aids tried in succession, each with fresh batteries and with the gain control of each set at maximum, to avoid the introduction of artifacts in testing. Second, the aided discrimination score should be taken for a list of PB words presented at a normal conversational level, such as 65 db. re 0.0002 microbar (about 40 db. on the hearing-loss dial of the speech audiometer) if the patient has a very great hearing loss, or at a low conversational intensity level, such as 45 db. (about 20 db. on the hearing-loss dial). Once again it is important that the gain control of the hearing aid be set identically for the tests before and after surgery.

If a patient with bilateral profound deafness due primarily to otosclerosis is being considered for bilateral stapes mobilization, the tests for binauralization should also be performed preoperatively and postoperatively with a binaural hearing aid.

Repeat Testing

Before a patient is operated upon the tests of his hearing function should be repeated one or more times over a period of from one to three weeks, to determine the stability of his hearing condition and to establish the reliability of his responses and of the test findings.

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† Reference 2. Bergman, M.: Letter to the Editor following article by Rosen.[4]

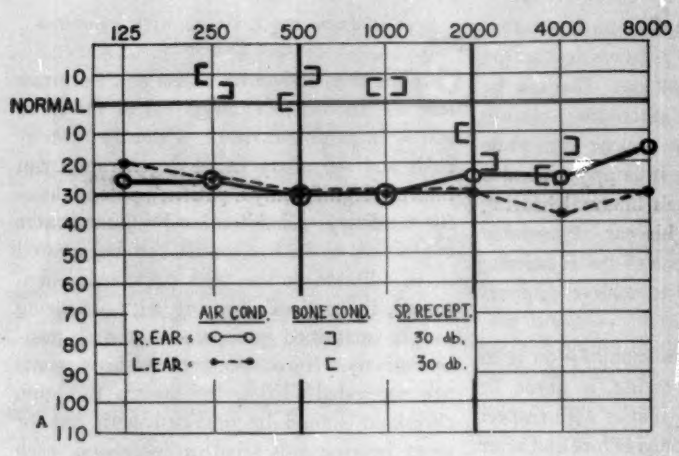

Fig. 4A (Case 3). — This patient with bilateral mild conductive deafness at the level of "social adequacy," which has often been considered the level of a successful result of fenestration surgery, reported to the surgeon's office with a complaint of handicapping deafness for many years. Her voice was soft and retracted, typical for patients with otosclerosis. With this deafness she must be considered hard of hearing.

COORDINATING STAPES MOBILIZATION AND AUDITORY REHABILITATION

When surgery is followed by a residual bilateral impairment of hearing sufficient to handicap the patient, supplemental assistance is required in order to achieve maximum rehabilitation. Not infrequently surgery which restores the threshold to a level of 30 to 35 db. short of normal hearing fails to remove the patient from the ranks of the hard of hearing. It has long been accepted practice in the field of hearing rehabilitation for children and adults with losses of that magnitude to receive instruction in lipreading. It has also been commonly observed that patients with such postoperative results continue to speak in the too-soft retracted voice which usually accompanies conductive deafness. Case 3 is typical (Figs. 4A and 4B).

Patients who have a larger hearing loss following surgery, whether the operation is successful or not in restoring some of their hearing, should have the benefits of a hearing aid, instruction in lipreading, and auditory training, in addition to help with their speech and voice problems and counseling on the psychological aspects of the handicap.

Much bitter disillusionment and misunderstanding can be avoided if the patient is given audiologic counseling as part of the preparation for the operation and rehabilitation measures are instituted immediately after surgery if indicated.

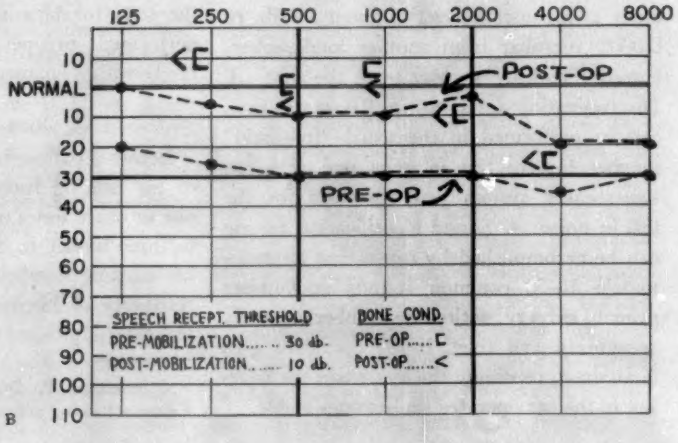

Fig. 4B (Case 3). — Results following successful stapes mobilization on the left ear.

SUMMARY

The emergence of brilliant surgical procedures for the restoration of hearing in deafness due to otosclerosis has brought new responsibilities to the otologist and to the audiologist. Surgery, such as stapes mobilization, can provide a patient with normal hearing or with hearing which can be utilized more effectively in a program of hearing rehabilitation. The best interests of the patient demand the closest cooperation among the professional workers who are specialists in the many facets of hearing and hearing function. Fortunately for the hard of hearing, the physician is moving with accelerated strides toward the elimination of deafness of the middle ear. Until the happy time when most deafness shall yield to medical science, supplementary measures of treatment must be provided and must be planned in accordance with experience gained in auditory rehabilitation.

The coordination of effort by the otologist and the audiologist and the expanding research into the causes and cure of deafness have been encouraging to those who have impaired hearing as well as to the professional workers who have dedicated themselves to auditory rehabilitation.

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Case Reports

TUBERCULOSIS OF THE MIDDLE EAR AND NASAL PASSAGES

Report of an Unusual Case

COL. BYRON G. McKIBBEN
and
CAPT. JAMES L. SHEEHY (MC), U. S. Army

TUBERCULOSIS of the middle ear is not common. It is, however, the second most frequent disease of tuberculous etiology seen by the otolaryngologist and should be suspected in any tuberculous person who develops painless otitis media.[1] Tuberculous infection of the nose and nasal fossae has been said to be the rarest form of localized tuberculosis.[2] The finding of both of these conditions in a healthy, young adult appears to be extremely rare and prompted us to report this case.

REPORT OF CASE

A 28-year-old Negro woman, in her ninth month of pregnancy, was admitted to Letterman Army Hospital, on Nov. 24, 1953, because of facial palsy associated with otitis media.

One month prior to admission, a sensation of fullness, without pain, accompanied by deafness and intermittent tinnitus, developed in the left ear. Penicillin was prescribed initially. Later the treatment was changed to oxytetracycline (Terramycin) and finally to erythromycin. During this period there was some purulent aural discharge.

One week prior to admission paralysis of the left facial nerve developed, and two days later there was dull postauricular pain on the same side. She was examined by an otolaryngologist, and a myringotomy was performed. The middle ear contained no pus or fluid, and there was no change in her symptomatology. Facial-nerve decompression was recommended.

History further disclosed that she had had dactylitis in childhood and, because of this, two fingers of the right hand had been amputated. Tonsillectomy and adenoidectomy had been performed in 1929. For a number of years she had been bothered with sneezing and nasal stuffiness. A right radical maxillary sinusotomy, in 1950, resulted in alleviation of the nasal symptoms for a period of two years. She had had no ear complaints until the present illness. She had lived in the United States all her life and, as far as she knew, had never drunk unpasteurized milk or been exposed to tuberculosis. She had had one previous pregnancy, with delivery of a normal child.

Physical examination revealed a complete lower motor neuron paralysis of the left facial nerve, without any sagging of the face. The left eye could be made to tear by stimulating the nasal mucous membrane. There was loss of taste sensation on the anterior two-thirds of the left side of the tongue. Polypi and mucopurulent material were seen in both nasal fossae. The left tympanic membrane was opaque, of a grayish-yellow hue, and the blood vessels on its surface were engorged. No perforation was visible. There appeared to be some bulging of the posterior portion, more marked superiorly and in the pars flaccida. Landmarks were indistinct. The appearance resembled that observed in subacute otitis media. Audiogram showed a 38 db. conductive hearing loss in the speech range. The third and fourth fingers of the right hand were missing. Small scars were noted in the right axillary and epitrochlear regions. She appeared to be about nine months' pregnant. The remainder of the physical examination was within normal limits.

Urinalysis, complete blood cell count, blood serology, and roentgenograms of the chest were within normal limits. Both mastoids were equally well pneumatized, and there was a questionable slight haziness of the left.

The initial impression was that of a cholesteatoma which had become sealed off from the external canal, resulting in expansion into the middle ear and erosion of the Fallopian canal. Failure of the mastoid x-rays to demonstrate a more definite abnormality tended to discount this. A myringotomy was done, but there was no pus or fluid in the middle ear. The tympanic membrane was thicker than normal. A small biopsy specimen was removed from the middle ear and histologic examination showed granulation tissue. No cholesterin crystals could be seen on smear, and cultures revealed no growth.

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From the Otolaryngology Service, Department of Surgery, Letterman Army Hospital, San Francisco.

After consultation with Col. Edward A. Zimmerman, Chief of the Obstetrical Service, and Dr. Shirley H. Baron, consultant in otolaryngology, it was decided that an attempt to induce labor should be made and that as soon as feasible after delivery exploration of the mastoid should be done. Cholesteatoma or tumor was suspected.

On Dec. 9, 1953, the patient was transferred to the Obstetrical Service and labor was induced. She gave birth to a normal baby girl and had an uneventful postpartum course. On the day of delivery, movement of the quadratus labii superioris was noted. During the following weeks there was steady improvement in facial function.

Inasmuch as facial function had begun to return, mastoidectomy was not performed and further attempts to establish a diagnosis were made.

On Dec. 18, 1953, soft, grayish-red, granuloma-appearing, sessile masses were removed from the nasal septum and from the middle and inferior turbinates bilaterally. These did not have the appearance or consistency of the usual nasal polyp. A small mass protruding from the site of the myringotomy wound was also removed. Histologic examination of both specimens showed granulation tissue, characterized by tubercle formations, which were consistent with tuberculosis. Acid-fast and fungus stains, however, failed to reveal the etiologic agent.

By Jan. 10, 1954, the nasal passages were nearly healed and the left tympanic membrane was intact, dull, and thickened. Facial function on the left side was good except for the frontalis and orbicularis oculi, which showed very little action.

Tuberculin test (purified protein derivative of tuberculin, 0.0002 mg.) was 2+. Coccidioidin and histoplasmin skin tests were negative. Serum protein determinations were equivocal; the globulin fraction was higher than usually seen in tuberculosis and lower than usually seen in sarcoidosis. A negative liver biopsy * tended to discount a diagnosis of sarcoidosis.

Review of the pathological report of tissue removed from the right maxillary sinus in 1950 showed nothing to suggest a chronic granuloma.

A transcript of records from the Cincinnati General Hospital disclosed that in childhood she had had tuberculous dactylitis, tuberculous epitrochlear lymphadenitis, and tuberculous axillary lymphadenitis. On Sept. 16, 1935, the third and fourth digits of the right hand, including the epiphysis of the corresponding metacarpal bones, had been amputated and an epitrochlear node and an axillary node on the right side had been excised. Histologic examination confirmed a diagnosis of tuberculosis. She received a course of deep x-ray therapy to the right axilla and was followed in the chest clinic until April, 1939, when she was dismissed, with physical examination revealing no undue abnormality.

Cultures for Mycobacterium tuberculosis remained negative. A guinea pig inoculated with tissue removed from the right nasal cavity on Jan. 10, 1954, developed only a localized abscess at the site of injection. A second guinea pig, inoculated with material from this abscess, died of widespread tuberculosis, and acid-fast bacilli were identified by smear and culture.

On May 12, 1954, the patient was started on streptomycin sulfate, 1 gm. twice weekly, and isonicotinic acid, 100 mg. three times daily.

During the course of treatment, she was seen periodically. Improvement was gradual, and by March 11, 1955, the nose appeared normal, the tympanic membrane was somewhat opaque and mildly scarred, the hearing was normal (6⅔ db. loss), and facial function was improved but showed some mass action on the left side, with epiphora at times. She was able to raise the left eyebrow fairly well and close the left eye. She still complained of mild tinnitus in the left ear.

Streptomycin sulfate was discontinued on June 17, 1955, but isonicotinic acid was to be continued another six months.

During the period of treatment she gave birth to her third normal baby.

COMMENT

Facial Palsy

Vascular congestion and edema in the vicinity of the facial nerve are responsible for paralysis, which clears up with the resolution of an acute suppurative otitis media. Where acute mastoiditis is present, pressure of pus in a cell communicating with the Fallopian canal and periostitis of the canal wall are additional factors which may produce facial-nerve paralysis.†

In chronic suppurative otitis media, the chief cause of facial palsy is cholesteatoma which has eroded the wall of the facial canal.†

In tuberculosis of the middle ear and mastoid, paralysis of the facial muscles may result from sequestration of bone, which involves the Fallopian canal.[2] Cases of this type have been reported.‡

* Performed by Col. Edward A. Cleve, Department of Medicine.

† Collier, J.: Facial Palsy, in Watkyn-Thomas,[3] pp. 745-777.

‡ References 4 and 5

Facial palsy, in our patient, developed early in the course of the middle-ear infection and began to subside in less than four weeks without therapy. Myringotomy ruled out an acute middle-ear suppuration; x-ray examination was not consistent with cholesteatoma and showed no more than a questionable haziness of the left mastoid, certainly no evidence of bony breakdown. The etiology of this facial-nerve paralysis is not clear, and while it has been stated that a diagnosis of Bell's palsy should be made only when there are no other neurological lesions and when there are no signs of disease or injury of the temporal bone,§ we are inclined to believe that our patient had a coincidental Bell's palsy.

Pregnancy

Whether the pregnancy, in this case, had anything to do with the activation of tuberculosis that may have laid dormant for 18 years is not known. The patient did, however, go through a previous pregnancy and postnatal period without apparent complication. Some investigators are of the opinion that during pregnancy and in the puerperium arrested lesions tend to become active. On the other hand, it has been observed that in some cases of active tuberculosis there is an apparent improvement in the disease during pregnancy. In general, the writers who are most optimistic about pregnancy having no ill effect upon tuberculosis deal with patients who can be put to rest and properly cared for during pregnancy and during the postpartum period, while the most pessimistic ones are usually those who observe the effect of childbearing upon tuberculosis in patients who cannot be given proper care and attention.[6] We believe that this patient's pregnancy was not a factor in the development of nasal and otic tuberculosis.

Nasal Tuberculosis

The nasal mucous membrane, with its bactericidal secretion and ciliary action, is the portion of the respiratory tract least liable to become the site of invasion by acute tuberculosis.[7] It is therefore suggested that in our case the nasal lesions resulted from a hematogenous implantation of tubercle bacilli from a focus elsewhere in the body, e. g., a lymph node in the right axilla.

Otic Tuberculosis

While primary tuberculosis of the middle ear has been said to occur,‖ it must be very rare indeed.¶

Infection may be direct: by passage of infected material up the auditory tube by coughing, sneezing, etc.; by spread along the tube from a nasopharyngeal lesion, or by hematogenous implantation.¶ Proctor and Lindsay [8] were of the opinion that the common pathway by which tubercle bacilli reach the middle ear is through the blood stream. In view of the difficulty with which tubercle bacilli were demonstrated in the nose of our patient, it is reasonable to assume that the infection was not the result of coughing or sneezing secretions into the Eustachian tube, but was the result of a hematogenous infection, either from the same focus that was responsible for the nasal infection or from the nasal lesion itself.

Diagnosis

Unfamiliarity with nasal and aural tuberculosis led to delay in suspecting the etiologic agent. The patient's good general health was another factor contributing to our failure to consider an extrapulmonary tuberculous process. The soft, grayish-red, sessile granulations located on the nasal septum and on the middle and inferior turbinates were similar to the tuberculous nasal lesions that have been described by Myerson [2] and Lederer.[7] The insidious onset of painless otitis media, the initial symptoms of which were deafness # and tinnitus, and the thickened, grayish-yellow tympanic membrane with engorgement of the surface vessels were

§ Collier, J.: Facial Palsy, in Watkyn-Thomas,[3] pp. 745-777.

‖ References 1 and 7.

¶ Reference 3, p. 720.

The early severe deafness noted in tuberculous otitis media is caused by extension into the inner ear (reference 2; reference 3, p. 720).

typical of the descriptions presented by Wallner [1] and Lederer.[7]

Even after tuberculosis was suspected, the final diagnosis was delayed because the guinea pig, inoculated with granulation tissue from the patient's nose, developed only a localized abscess at the site of injection. Because of the possibility that such a reaction in a laboratory animal may be the result of infection by saprophytic acid-fast bacilli or pyogenic micro-organisms, inoculation of a second guinea pig with material from the abscess in the first animal was necessary.[9]

When the number of living tubercle bacilli injected into a laboratory animal is relatively few, generalized tuberculosis, or even a localized lesion, may fail to develop.[9] Thus, it may be postulated that the tubercle bacilli in the granulation tissue in our patient's nose were too few to give positive cultures or to produce widespread tuberculosis in a guinea pig.

SUMMARY

The insidious development of painless otitis media, associated with early severe deafness, is sufficient cause to suspect tuberculosis as the etiologic agent.

One case of tuberculosis of the middle ear and nasal passages, associated with facial palsy, in an apparently healthy, pregnant young woman is presented and briefly discussed.

Tokyo Army Hospital, 8059 Army Unit, APO 500, San Francisco.

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LEUCOPLAKIA OF THE NASAL SEPTUM

EDLEY H. JONES, M.D., Vicksburg, Miss.

AT A RECENT meeting of the American Academy of Ophthalmology and Otolaryngology I made a round of all publishers' booths, reviewing the subject of leucoplakia in all books on otolaryngology. Surprisingly, some authors did not even mention leucoplakia; most did discuss leucoplakia of the mouth, palate, or throat, but only one mentioned leukoplakia of the nose—and that one did not mention leucoplakia of the septum. The following case is presented because of its rarity.

REPORT OF CASE

A white man, married, civil engineer, aged 67, was first seen April 9, 1952, complaining that he had had a "little bleeding occasionally" from the right naris for the previous six months; had caught a head cold some three weeks before his visit and the bloody discharge had been worse since that time. He had previously consulted his family physician, who had made a general physical examination and found his blood pressure slightly elevated; but the pressure had returned to normal under treatment.

Examination revealed irritation of the right Kisselbach's area, and it was thought he had traumatized it with his fingers, handkerchief, or tissues. Ten per cent silver nitrate solution was applied to the area, and a cotton pack, saturated with liquid petrolatum (mineral oil), was inserted for six hours. Mild oily nose drops were prescribed, and the patient was instructed not to insert fingers, handkerchief, or tissues into the nares.

There was no hemorrhage until two weeks later, when he had a moderate amount of bleeding from the same naris while mowing the lawn. When examined that afternoon the area appeared healed. A week later he had a little bloody discharge but no real hemorrhage. He was seen at irregular intervals, but on July 21, 1952, the lesion had a gray-pink appearance. He was seen again, on Aug. 4, 1952, with the history of a small amount of hemorrhage on each of the three previous days, only a small amount and quickly controlled; examination revealed an irregular lesion, slightly less than 10 mm. in diameter, grayish-white in color, apparently firmly adherent to the septum, suggesting scar tissue, surrounded by thickened, congested mucosa. On that date a tentative diagnosis of leucoplakia was made and surgery was advised.

Preoperative physical examination and routine laboratory studies, including serology, revealed normal findings.

On Aug. 12, 1952, he was operated on at the Vicksburg Hospital under local anesthesia. An incision was made through the mucosa to the cartilage on the right side of the septum, completely circumcising the lesion, with an adequate area of normal mucous membrane. A vertical incision was then made on the right side of the septum at the mucocutaneous junction. The septal mucosa was carefully elevated posteriorly until the margins of the circumlesion incision were encountered, and the right septal flap was freed anteriorly, superiorly, inferiorly, and posteriorly, leaving intact the mucosa surrounding the lesion. The quadrilateral cartilage was incised and the left septal flap completely elevated, without perforation. A Ballenger swivel knife was inserted and the major portion of the quadrilateral cartilage was removed intact, with the lesion and surrounding mucosa adherent. A small incision was made posteroinferiorly for drainage, and the anterior incision was closed with two black nonabsorbable surgical (silk) sutures. Three strips of dental wax were inserted in each naris; five were removed the following day, but one strip was allowed to remain in the right naris for three days. The sutures were removed on the sixth postoperative day. The septum healed in approximately one month, but the patient was kept under observation for another month before discharging him.

The pathological examination was made by Dr. R. H. Fenstermacher, and his interesting report follows:

"Tissue from the nasal septum:

"Gross: The specimen is a somewhat triangular-shaped piece of tissue, measuring 32×24 mm. and averaging 4-5 mm. in thickness, from the nasal septum. A raised gray, pink, indurated, thickened and fairly circumscribed area measuring 16×14 mm. is present on the central portion of the mucosal surface of the specimen. Normal appearing mucosa completely surrounds this raised thickened area. A thin

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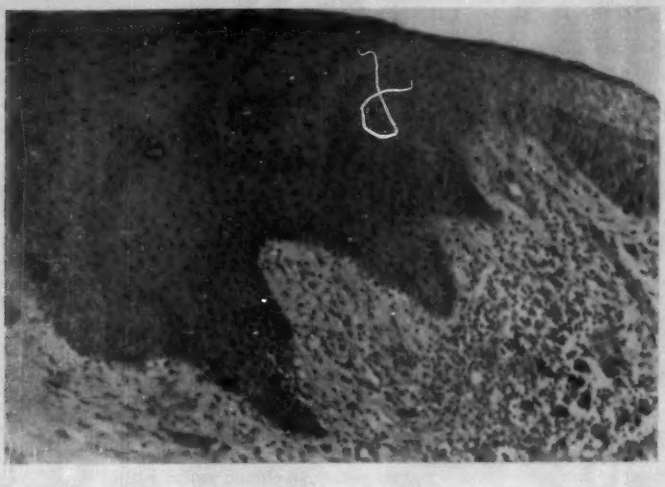

Section of specimen from the nasal septum; reduced ⅜ from mag. × 450 (microphotograph by Fenstermacher).

layer of cartilage is present on the under surface of the specimen.

"Microscopic: Sections of the specimen from the nasal septum show a slightly inflammatory fibrous connective stroma covered over by epithelium. The epithelium in the central portion of the specimen is a thickened and typically leukoplakic type of squamous epithelium characterized by slight to moderate hyperkeratosis and some acanthosis. The hyperkeratotic portion forms a thin horn-like crust on the surface of the nasal septum. The acanthotic portion of the epithelium is made up of well differentiated cells and there is no malignant transformation. Normal appearing transitional mucosa is present around this thickened leukoplakic area. Small infiltrates of lymphocytes and a few tiny hemorrhages are present in the subepithelial connective stroma.

"Diagnosis: Leukoplakia of nasal septum."

The patient was last seen on Dec. 5, 1955. Examination at that time revealed no evidence of recurrence.

Perhaps because of its rarity, comparatively little is known about leucoplakia. Tobacco and syphilis are thought to be predisposing factors, but this patient has never used tobacco and his serology was negative. It is generally considered a precancerous lesion.

1301 Washington St.

Clinical Notes, New Instruments and Techniques

DEPTH KNOTTER

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Hemostasis during the course of every operation must be complete. It is a condition of general surgery. Every vessel that bleeds must be fastened; even if it stops bleeding momentarily, there is danger of secondary hemorrhage. This is more important when local anesthesia is used. After the compression by anesthesia the secondary hemorrhage occurs. These concepts prevail also in tonsillectomy.

Many times because of lack of practice in making a knot with the fingers or because of the patient's indocility, less effective methods are applied.

Frequently the compression of the cavity is made with gauze, or procaine is infiltrated, or attrition is made with forceps, which later are removed.

I think that hemostasis can be made as thoroughly as in any other operation with the help of the knotter. It is an original instrument designed to make knots in depth. Its principal use is to fasten vessels in tonsillectomy by carrying and fastening a running knot in the tonsillectomy cavity.

The instrument contains (*a*) a tube which carries the bow knot and the ready-made knot, (*b*) a handle that pulls the suture (gut) and closes the knot, and (*c*) two small plates that hold the other end of the suture. The traction of the handles is sufficient to tighten the knot, and the tension of the knot depends on the intensity of the traction.

The knot remains firm, and a double knot is not necessary. To place the knot and fasten it takes only three or four seconds, and then one simply cuts the suture. With this knotter one can make the knot with one hand, while the other hand holds the forceps. After a knot is made the instrument remains threaded, and various knots can be made with the same suture on the same patient.

The instrument is very useful in tonsillectomy where general anesthesia is used and in tonsillectomy where local anesthesia is used even in patients with marked pharyngeal reflex. It may be used to fasten the vessels of the inferior pole. Wherever it is possible to place forceps it is possible to knot with the instrument. The knot has been seen three or four days after operation.

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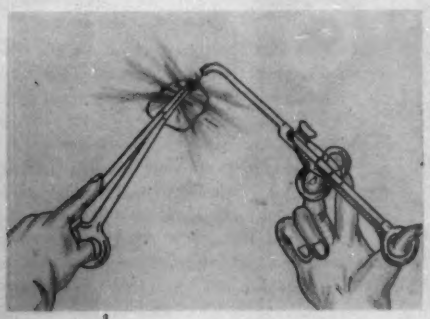
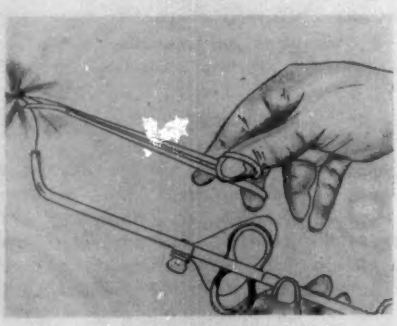




SUGGESTIONS FOR THE USE OF THE KNOTTER

It is preferable to sterilize the instrument by placing it in alcohol for three hours. Do not sterilize by boiling, so as to avoid the formation of oxide in the interior of the tube. For this purpose three knotters are to be placed in a sterilized box.

The suture to be used will be absorbable surgical (gut) suture No. 1 from one tube.

If the operation is with general anesthesia it is preferable to have knotters ready with the suture before the operation begins.

If the operation is done with local anesthesia, the knotters can be threaded while the procaine is taking effect.

To take the vessel that bleeds, the use of a special tonsil forceps is essential, for fastening the tonsil one that is curved at the extreme end, without teeth, and fine-pointed. With the forceps take only the vessel that bleeds, not a superficial one, exert slight traction, and the knot will be made 2 or 3 mm. distant from the forceps. To make the knot at that point it is enough to place the end of the tube at that distance; of course, the knot will be made at the end of the instrument.

Practice teaches the traction that is necessary for the suture. The suture must be cut 2 or 3 mm. from the knot.

With the suture remaining in the knotter another knot can be made on the same patient.

The instrument should be washed immediately after use, and wire should not be used to clean the inside of the tube.

Dario Urzua 1552.

SIMPLE PRESBYOPIC LENS FOR HEAD MIRROR

EPHRAIM L. MANNING, M.D.
Davenport, Iowa

The most used presbyopic lens for a head mirror is attached by a cumbersome spring arrangement. I had a lens made up which is cemented on to the back of the head mirror. This lens is just slightly larger than the opening of the mirror and is beveled so that it projects very little.

It can be made up by any optician and has been found very convenient and useful. The lens in the illustration was made up by the House of Vision.

1020 First National Building.

Accepted for publication Nov. 22, 1955.

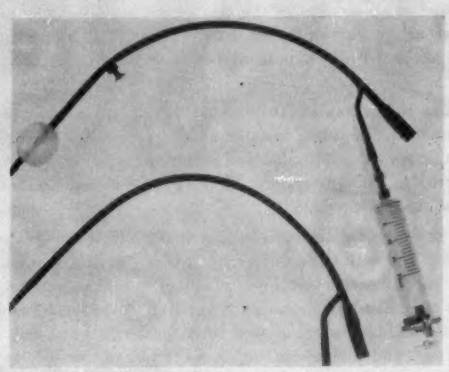
THE CONTROL OF ADENOID HEMORRHAGE WITH A FOLEY CATHETER (BALLOON TYPE)

FORDYCE JOHNSON, M.D.
Pasadena, Calif.

In the past the control of adenoid bleeding has been by the application of gauze sponges, cauterizing solutions, vasoconstrictors, and the tying of those vessels low enough in the nasopharynx to reach with a forceps. At times the bleeding persists, requiring the use of a postnasal pack.

The routine with a postnasal pack is the use of a large gauze sponge with three strings, one for each nostril and the third coming out through the mouth, the third string to facilitate the removal of the pack at the end of a period to assure the control of the bleeding. The removal of the pack is most uncomfortable, requiring sedation and the use of an analgesic.

In an effort to find a simpler procedure to control adenoid bleeding, a 30 cc. balloon Foley catheter has been used, with marked success. When it is seen that adenoid bleeding is not



Foley balloon catheter.

being controlled by routine measures, a No. 16 F. Foley catheter, balloon type, 30 cc. capacity, is slipped through either nostril into the nasopharynx. The balloon is partially inflated with use of a 20 cc. syringe; the catheter is clamped with a hemostat and drawn into the adenoid region. Additional air is then put in the balloon, so that firm pressure is obtained in the nasopharynx. Traction is exerted on the hemostat while a screw clamp from a transfusion set is placed on the catheter at the nostril, followed by a gauze dressing between the clamp and the nostril. This prevents localized pressure from the clamp and maintains traction on the balloon. The nasopharynx is then checked to assure bleeding is being controlled.

During the period the patient is coming out of the anesthetic it is important to keep an airway in the mouth. The balloon does encroach on the mouth breathing; however, when the patient is fully awake he does not seem distressed, although breathing is noisy.

At the end of 6 to 24 hours, when bleeding seems well controlled, the catheter may be removed. This is a simple procedure, not requiring a sedative or analgesic even in the most difficult patient. The clamp is unscrewed slowly, deflating the balloon, and the catheter is gently drawn out through the nose without distress to the patient.

The Foley balloon catheter is recommended because it is readily available in every hospital. The catheter may be used several times, thus reducing the cost per patient. The insertion of the catheter is easy, without trauma; and its removal is simple, with no discomfort to the patient.

Examination of the literature has not shown a report on the control of adenoid bleeding by this procedure.

98 N. Madison Ave.

Accepted for publication Aug. 23, 1955.

Presented before the Pacific Coast Oto-Ophthalmological Society Meeting, Portland, Ore., May 17, 1955.

A RETROAURICULAR PEDICLE SKIN GRAFT TO LINE THE RADICAL MASTOID CAVITY

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Cebu City, Philippines

The purpose of this report is not to amplify on the merits and advantages of skin grafting of the radical mastoid cavity, as it is a tried and well-proved procedure, but rather to show a simple way to obtain an ample, resistant, viable graft.

Lempert [1] utilized the small sections of the skin of the posterior auditory canal; House,[2] skin from the postauricular area; Farrior,[3] skin from the thigh; Campbell,[4] skin from the inner surface of the arm; Myers and Wilf,[5] skin from the cavum conchae, modifying Lempert's endaural incision.

Skin grafting is time-consuming and tedious and needs an assistant adept in the use of the dermatome. Skin taken from the thigh, arm, or abdomen provides a large graft, as desired, but the denuded area also leaves an undesirable and mutilating scar, especially distasteful to women. Also, success of this graft is not very certain. Skin from the cavum conchae is limited in amount, not enough to line the mastoid cavity.

The skin graft in my case was essentially like that of House,[2] Mosher,[6] and Khan [7]: from the retroauricular area. The only basic difference is that the skin flap was a pedicle, remaining attached at its upper end to ensure viability, adequate nutrition, resistance to infection, and sure take. The modified endaural incision of Shambaugh [8] was used and the entire cutaneous covering of the external auditory canal as well as its posterior bony wall was found necrotic, so much so that the antrum and middle-ear cavity were already united, full of aural polyps and debris.

After the mastoidectomy, a flap was created. The first incision was made at the posterior attachment of the pinna, following its curvature downward to the back of the lobule. The second parallel incision was made posterior to the first. (This incision may be extended even up to the hair line, depending on the width of the flap desired. The lower ends of the first and second incisions may also be extended to the neck if a longer flap is required.) A third incision joined the two below, and the skin was rapidly dissected with scissors.

In effect, the result was a full-thickness tongue of skin with its base up. The skin flap was then inserted through a buttonhole in the remaining connective-tissue attachment at the base of the pinna and spread out in the mastoid cavity. The buttonhole should be at the level or a little higher than the floor of the external auditory meatus. Petrolatum (Vaseline) gauze kept the graft in place, and the postauricular wound was closed by nonabsorbable surgical (silk) sutures. (The base of the flap may or may not be severed later.)

Five days later the gauze packing was removed; the skin graft was already firmly attached to the underlying bone and the postauricular wound healed by first intention. Contracture of the meatus usually occurs at its posteroinferior quadrant in the process of healing. In this case, that area was entirely covered with healthy skin, so that the opening remained wide, with no danger of stenosis in the future.

SUMMARY

A case is reported wherein a retroauricular pedicle skin graft was used to line the radical mastoid cavity, a graft simply and rapidly prepared, viable, ample, resistant to infection, and certain of take.

348 Jones Ave.

Accepted for publication Dec. 9, 1955.

Fig. 1.—Healed bed of the pedicle skin graft, which looked rough because the crust had not yet been removed after taking out the stitches. Note slight puckering at the upper end, which is the root of the graft not severed, and the level of the buttonhole, where graft was inserted into the mastoid cavity.

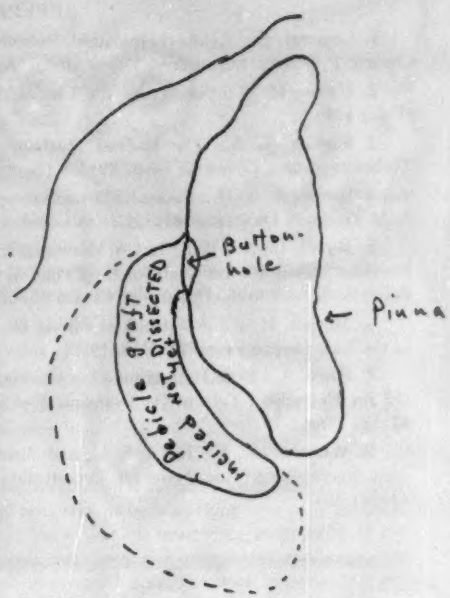

Fig. 3.—Pedicle graft incision made; also the buttonhole. Broken line indicates a larger graft, if desired.

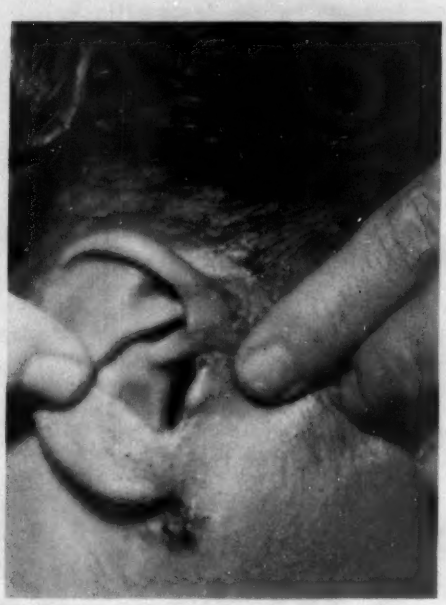

Fig. 2.—Note wide open external auditory meatus. Above helix endaural incision, and below the lobule the lower end of the graft incision.

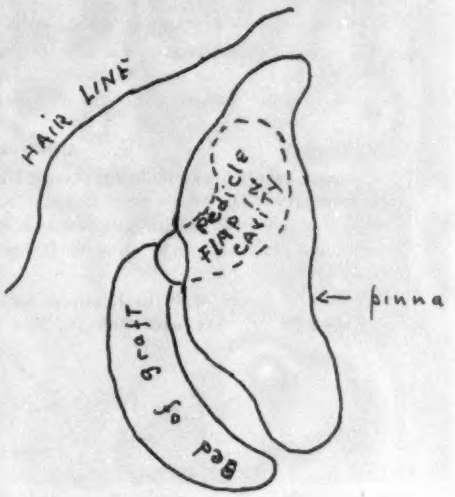

Fig. 4.—Denuded bed of graft; the pedicle flap inserted through the buttonhole and lining the mastoid cavity.

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News and Comment

GENERAL NEWS

American Hearing Society Moves.—National headquarters of the American Hearing Society moved to 1800 H St., N.W., Washington 6, D.C., Jan. 1, 1956. The agency has occupied offices at 817 14th St., N.W., in Washington since 1948.

Attractive, conveniently arranged, and providing improved working conditions for the staff, the headquarters include a reception room, secretaries' bay, six private offices, conference room, department for mailing literature and handling *Hearing News* subscriptions.

The new headquarters are located in a remodeled building, whose owners redecorated and subdivided the 12th-floor space to specifications of the American Hearing Society's Executive Director, Crayton Walker. All of the offices are air-conditioned.

ANNOUNCEMENTS

Postgraduate Course in Rhinoplasty, Reconstructive Surgery of the Nasal Septum, and Otoplasty.—The Mount Sinai Hospital, New York, in affiliation with Columbia University announces an intensive postgraduate course in Rhinoplasty, Reconstructive Surgery of the Nasal Septum, and Otoplasty, to be given by Irving B. Goldman, M.D., and staff July 14, 1956, to July 28, 1956.

Candidates should apply to Registrar for Postgraduate Medical Instruction, The Mount Sinai Hospital, 5th Ave. and 100th St., New York 29.

AN AID TO TONSILLECTOMY AND ADENOIDECTOMY IN THE HEAD-LOW POSITION

LINDEN J. WALLNER, M.D.
Chicago

Tonsillectomy and adenoidectomy is the commonest surgical operation, and it is natural that there should be a great variety of instruments and methods available for its performance. Almost any of these are satisfactory for surgeons experienced in their use.

The head-low, or so-called "upside down," position with the Crowe-Davis mouth gag is becoming more commonly used, indicating certain inherent advantages. The merits of the method may be listed as follows:

1. The airway is maintained by holding the tongue and hyoid structures forward.
2. Blood and secretions drain away from the operative field and the larynx.
3. Excellent exposure is obtained without constant manipulation of the tongue. This encourages careful removal of lymphoid tissue and complete hemostasis.
4. No assistant is necessary.

This method has certain disadvantages when the anesthetist is required to support the handle of the tongue blade manually. It becomes heavy and fatiguing, as he is working with poor leverage. Since he is not viewing the throat, it is difficult to know that the head is correctly held. If the tongue blade is not supported properly the head may become flexed, obstructing the airway by allowing the epiglottis to fall against the posterior pharyngeal wall. Frequent movement of the tongue blade may place a strain upon the upper teeth.

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Read before The Chicago Laryngological and Otological Society, Dec. 5, 1955, with the presentation of the motion picture "Technique of Tonsillectomy and Adenoidectomy."

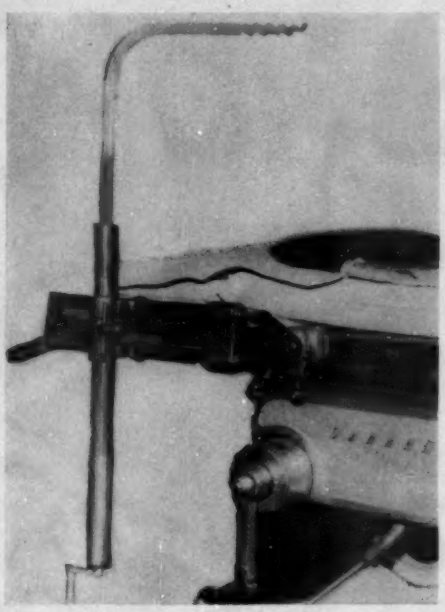

Fig. 1.—Killian gallows, used in suspension laryngoscopy.

Fig. 2.—Set-up used in head-low tonsillectomy and adenoidectomy. McIvor mouth gag is suspended from Killian gallows.

Because of these difficulties the tongue blade is often hung or supported from the frame of a Mayo instrument stand. This was found to be an improvement but not entirely satisfactory. The stand is not rigid and tends to slip on the floor, so that frequent readjustment is necessary. Also, the tilt of the table for the Trendelenburg position cannot be adjusted without first disengaging the tongue blade.

The Killian gallows (Fig. 1) used for suspension laryngoscopy seemed to offer a stronger and more rigid support for the Crowe-Davis tongue blade. The two screw handles allow delicate adjustments horizontally and vertically. As the gallows is attached to the table the tilt may be altered without disconnecting the tongue blade.

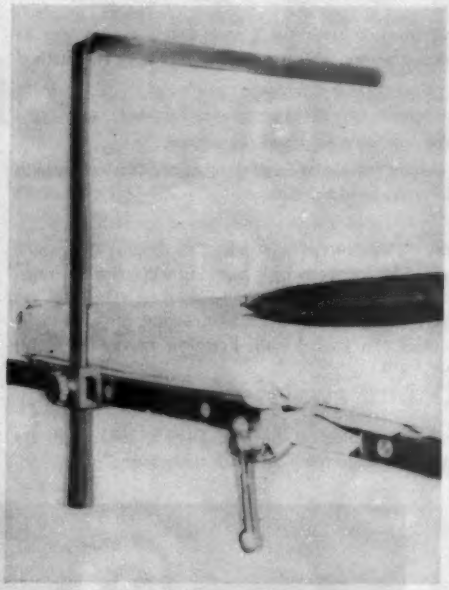

Fig. 3.—Easily made substitute for the Killian gallows, used with sliding clamp present on many operating tables.

This method of supporting the Crowe-Davis or McIvor (Fig. 2) tongue blade has been used for the past three years with most satisfactory results. The new Barton tongue blade for the endotracheal tube fits either the Crowe-Davis or the McIvor mouth gag and may be supported from the arm of the gallows in a similar manner.

The suspension gallows has been found so valuable that it has been sorely missed when operating at other hospitals where none was available. Since it is rather heavy to transport and quite expensive for only occasional use, an effective substitute has been designed. Most operating tables have sliding clamps at the sides to fasten shoulder supports, stirrups, or ether shields. A piece of stainless steel ¼ in. thick, 1 in. wide, and 36 in. long is heated and bent at right angles so that one arm is 16 in. long, the other 20. The shorter arm is then twisted 90 degrees so that the thin edge is upright. Several rounded notches are cut to hold the handle of the tongue blade (Fig. 3). The one set screw in the clamp attached to the table allows both horizontal and vertical adjustments.

122 S. Michigan Ave. (3).

Progress in Otolaryngology

BRONCHOESOPHAGOLOGY

Summaries of the Bibliographic Material Available in the Field of Otolaryngology for 1954

F. JOHNSON PUTNEY, M.D., Philadelphia

FUNDAMENTAL advances in anatomy, physiology, and pathology in relation to bronchoesophagology were scarce in 1954. A revival of interest in bronchial adenoma brought out the increasing use of surgical excision in the treatment. Diseases of the esophagus continued to receive more attention, particularly regurgitant esophagitis.

EXPERIMENTAL STUDIES

Croxatto and Lanari [1] considered all cases of bronchiectasis, whether acquired, primary, or secondary, to be caused by bronchial obstruction. Experiments performed on dogs revealed that complete bronchial obstruction leads to bronchoalveolar apneumatosis. The secreted mucus could not find an external outlet, and so the bronchus became dilated, producing the first phase of obstructive bronchiectasis. The mucus bronchodilatation was found to either disappear early or become permanent at a later time, leading to bronchiectasis.

Radioactive barium sulfate particles were administered intratracheally to rats by Cember and co-workers [2] to study pulmonary penetration and distribution. Although the particles were generally found in all lobes of the lungs, the distribution was not uniform, with about 40% of the material being deposited in the deep respiratory tract.

In attempting to determine the effect of incendiary phosphorus bombs on the human bronchial tract, Bayer [3] experimented with a number of animals by burning the epithelium of the larynx and trachea with white phosphorus. The following were noted: (1) destruction of the epithelium, (2) inflammatory infiltration of lymphocytes and leucocytes under the mucous membrane of the larynx and trachea, and (3) bronchopneumonic spots in the lungs. Phosphorus has been used in modern warfare as an ingredient of bombs and shells, and a number of patients with poisoning developed severe suffocation necessitating a tracheotomy. For protection gas masks are especially effective, but it is usually sufficient to breathe only through a wet towel or wet handkerchief. More protection can be afforded if the towel is wet with a solution of potassium permanganate, which converts the phosphorus oxide into acids, thereby preventing penetration into the bronchial tree.

Bickerman [4] experimented with exsufflation and negative pressure in removing metallic foreign bodies from dogs' bronchi. In eight animals within two hours after insertion of the foreign objects elimination occurred after 18 to 36 exsufflations. In seven of the nine animals which were treated from one to four days after introduction of the foreign bodies, successful evacuation took place after approximately 24 exsufflations. The two failures in this series were attributed to the foreign objects becoming firmly wedged in the bronchial tree.

In dogs, Pacheco and co-workers [5] found that end-to-end anastomosis of the trachea must be carried out using a nonabsorbable material for sutures, in order to hold the ends of the anastomosis together in any form of reconstructive surgery of the trachea. The infectious factor must always be considered when surgery is performed in either the trachea or bronchi, and in the light of present knowledge the use of either fresh or preserved homotopic homografts was not advised. It was found possible to use either

Accepted for publication Nov. 15, 1955.

heterotopic autografts or homografts in repairing small defects in the trachea.

ANESTHESIA

On the basis of material comprising 441 peroral endoscopies, Anderson and his associates [6] experienced satisfactory analgesia with meperidine (Pethidine, Demerol). Slow intravenous injection of 100 to 200 mg. of meperidine without any premedication produced good analgesia and usually complete relaxation of the cricopharyngeus for esophagoscopic examination. In bronchoscopy the meperidine injection was supplemented by local surface anesthesia applied to the larynx in order to abolish the laryngeal reflex. It was emphasized that too rapid injection with too large a dose of meperidine in patients in poor general condition produced a certain risk of respiratory depression, and great caution should be exercised in using this medication in patients with respiratory impairment.

In a series of 64 patients tripelennamine (Pyribenzamine) was employed as a topical anesthesia for peroral endoscopy by Kleitsch.[7] Because the induction period was found to be excessively long the solution was combined with tetracaine (Pontocaine), with resulting improvement in the anesthesia obtained. In general 20 cc. of a mixture containing 1% tripelennamine and 0.5% tetracaine with a total dose of 200 mg. of tripelennamine and 100 mg. of tetracaine was employed. The anesthesia was described as superior to that obtained by tetracaine or cocaine alone. Because of the potential danger from the large dose of tetracaine the amount of solution used was reduced to 10 cc., thus cutting the dosage in half, and the anesthesia was found to be adequate with rapid induction. The side-effects of tripelennamine were described as desirable rather than harmful, but the exact toxicity of the mixture as compared with cocaine or tetracaine solution alone was not determined by this study.

CONGENITAL ANOMALIES

Two unusual cases of congenital abnormalities occurring in infants in association with tracheoesophageal fistula were described by Sayre and Hall.[8] In one case there was a subglottic cartilaginous stenosis and in the other cartilaginous atresia at the subglottic level.

Ferguson and Flake [9] recorded their method of diagnosis of congenital anomalies of the tracheobronchial tree and of the aortic arch compressing the trachea and esophagus. Patients with tracheal compression developed inspiratory stridor due to alteration in the caliber of the tracheal airway when there was no laryngeal abnormality. In patients with stridor and a normal larynx examination of the trachea should be carried out. The use of general anesthesia enabled the authors to perform more searching and complete endoscopic and iodized-oil studies on the patients with a minimum of trauma and a maximum of safety. Although the majority of the patients were young infants, subglottic edema of clinical significance rarely occurred and in no instance was tracheotomy required. Iodized oil (Lipiodol) was used in regulated amounts in even the smallest infants, and the procedures were carried out quickly, with removal of the oil by suction immediately after roentgen studies had been made. Sensitivity to iodized oil was not encountered in the 18 years in which this method was used.

Mullard [10] reported two cases of congenital tracheoesophageal fistula without atresia of the esophagus. In one case a barium swallow showed the fistula passing from the esophagus to the left main bronchus. The mouth of the fistula could not be seen at esophagoscopy, and it was only found with difficulty at bronchoscopy because of the very small bronchial lumen. In the other case esophagoscopy suggested a fistula 27 cm. from the upper incisor teeth, while on bronchoscopy there was a suggestion of a fistula on the posterior wall of the right main bronchus, and the definite diagnosis was made by barium swallowing function.

Sarkissian [11] reported a case of congenital esophageal atresia which was unusual in the fact that the site of the tracheoesophageal

communication was in the neck about 0.5 cm. below the level of the cricoid cartilage.

Mathey and Lemoine [12] reported a case of congenital esophagotracheal fistula without atresia and with a tracheal diverticulum. The presence of an esophagotracheal fistula was confirmed on bronchoscopic examination, but the tracheal diverticulum was not found until operation.

Two cases of tracheoesophageal fistula without atresia in babies were reported by Goulston.[13]

Ware and Cross [14] reported a case of congenital tracheoesophageal fistula without atresia of the esophagus.

Caldwell [15] described a case of congenital tracheoesophageal fistula in an adult.

A case of agenesis of the left lower lobe with congenital stenosis of the left main-stem bronchus was reported by Storey and Marrangoni.[16]

TRACHEOPATHIA OSTEOPLASTICA

Heyden [17] reported a case of tracheopathia osteoplastica and called attention to the bronchoscopic findings of the numerous nonulcerated protuberances of the mucous membrane covering the trachea. The etiology still remains obscure.

TRAUMATIC TRACHEAL FISTULA

A case of massive fatal hemorrhage from a tracheocarotid fistula following tracheotomy was reported by Schenken and Brown.[18] The lesion was caused by the constant erosive lateral movement of the tracheotomy tube, which was so long that it rested upon the carina. The to-and-fro pressure exerted upward by the carina produced the excessive lateral excursion.

TUMORS OF TRACHEA

In discussing tumors of the trachea, Moersch and his associates [19] considered bronchoscopy to be the most valuable aid in the diagnosis. Not only can tissue be removed directly from the tumor for microscopic examination or secretions and smears secured for cytologic study but also exact localization of the tumor can be accomplished. The treatment of tracheal tumors is dependent to a large degree on the type of tumor present, and occasionally removal can be accomplished endoscopically. In carcinoma of the trachea when surgical extirpation cannot be done, destruction of the tumor by electrocoagulation directly through the bronchoscope or through a tracheostomy may afford considerable relief.

FROZEN-SECTION BIOPSY

Aprigliano and Torres [20] advised that the frozen-section method for histologic diagnosis be used during endoscopic examinations. The method was found to be reliable and shortened the time necessary for histologic diagnosis. At times, tissue removed at endoscopy is not sufficient for histologic diagnosis by means of the routine methods, so that it becomes necessary to repeat the endoscopic procedure to secure additional tissue. Additional or subsequent bronchoscopies can be obviated by routine frozen-section examination of tissue.

BRONCHOSCOPY IN DIAGNOSIS

In discussing the diagnostic value of bronchoscopic examination, Olsen [21] emphasized that considerable discretion should be used in advising bronchoscopy. In many cases of thoracic disease the examination has little value and should not be recommended routinely. This is especially evident in cases of mediastinal tumor, early tuberculosis, or solitary peripheral nodules of the lung. Patients who have hemoptysis, stridor, wheezing, cough, or x-ray evidence of lesions which may be producing bronchial obstruction need diagnostic bronchoscopy. Bronchoscopy is also indicated in patients who give a history of retention of sputum and in those in whom pneumonic episodes fail to clear up rapidly. The possibility of an early bronchogenic carcinoma must always be kept in mind, and any unresolved pneumonia or other evidence of bronchial obstruction should be promptly investigated. In respiratory illnesses of children bronchoscopy is especially useful, for it may prevent

many of the crippling diseases which later affect the youngsters.

Lynch [22] described the bronchoscopist's aid to the thoracic surgeon and advised endoscopists to increase their knowledge and improve their skill so that they would become indispensable. In bronchogenic carcinoma the diagnosis can be made earlier and more positively by bronchoscopy than by any other available means. In addition to obtaining biopsy specimens and secretions for study the examiner can obtain descriptive information concerning the tracheobronchial tree. Widening of the carina, distortion and fixation of the bronchi, rigidity and absence of expansion, and elongation of the bronchi on inspiration and contraction on expiration indicate peribronchial involvement and should be of considerable help to the thoracic surgeon. Bronchoscopy is needed in all patients with a persistent, chronic, productive cough if the diagnosis of carcinoma is to be made at a time when the lesion is still operable, and in the event of persistent symptoms with negative endoscopic and inconclusive roentgen findings exploratory thoracotomy is indicated.

BRONCHOSCOPY IN PULMONARY TUBERCULOSIS

In reviewing 200 bronchoscopies in pulmonary tuberculosis, Lehmann [23] pointed out that the frequency of endobronchial tuberculosis was comparatively high before the introduction of the antituberculous drugs. In this material the incidence of endobronchial tuberculosis was 15%, as compared with 30% or more in the prestreptomycin era. With the introduction of the antituberculous drugs endobronchial ulceration and granulation have healed without scar formation and without bronchial stenosis, with its resulting atelectasis, lung abscess, and empyema. The deformities revealed by bronchoscopy in pulmonary tuberculosis were rotated carina, angulated bronchi, buckling of bronchi, and collapsed bronchial openings. Secondary rise of temperature with spread or reactivation of the lesion following bronchoscopy was not observed in any case, for modern treatment methods prevented occurrence of these aftereffects.

In 1228 bronchoscoped tuberculous adults, Iselin and Suter [24] found a postprimary tuberculous hilar lymph node perforation 38 times and in 81 cases the findings were regarded as residuals of such perforation. This condition is not rare, and secondary pulmonary tuberculosis can develop because of the hilar node perforation, so that early recognition of the process is necessary.

COMPLICATIONS OF ENDOTRACHEAL ANESTHESIA

Five cases of subglottic membrane following endotracheal anesthesia were reported by Feinmesser and his co-workers.[25] The symptoms were so severe that bronchoscopy or tracheotomy was needed for relief of symptoms. In two of the cases, mechanical trauma at the time of introduction of the tube was considered to be the responsible factor. Since all the cases occurred in women and children the use of a relatively large tube in a small laryngeal airway was considered to be the responsible factor. In order to minimize the traumatic element, positioning, full relaxation of the larynx, and gentle use of a suitable laryngoscope and of tubes of the correct size were advocated. The opinion was expressed that endotracheal anesthesia should not be used indiscriminately, and more precautions were recommended in order to avoid laryngotracheal complications.

A case of bilateral granuloma of the larynx was reported by Melick and his co-workers.[26] The cause of the granuloma was assumed to be due to movement of the larynx over the intratracheal tube during too light a plane of anesthesia.

In cardiac arrest Flagg and Flagg [27] were unable to find any evidence to suggest that bronchoscopy or endotracheal intubation per se precipitated cardiac arrest. In any case of cardiac arrest the first and immediate treatment is endotracheal insufflation of oxygen under sufficient pressure to excite the Hering-Bruer reflex.

BRONCHOGRAPHY

Schmidt and Donoghue [28] utilized the catheter method for bronchography and described the indications and contraindications to bronchography as the same with the water-soluble media as with the iodized-oil media. In general the water-soluble materials have their chief value for patients with pulmonary tuberculosis by eliminating the risk of spread of the disease. The complications after the use of water-soluble media were febrile reaction and pneumonitis. Those following the use of iodized oils were allergic reaction, swelling of the salivary glands, anaphylactic shock, and pulmonary granulomas. The chief value of bronchography lies in the demonstration of the presence or absence of bronchiectasis.

Bernstein [29] employed selective segmental bronchography to determine the nature of doubtful abnormal shadows or other structural changes in 25 patients. A Metras catheter was introduced under the fluoroscope into the lung segment in question, and after proper local anesthesia a small amount of water-soluble contrast medium was injected and spot films taken.

Zheutlin and his co-workers [30] described a new diagnostic roentgen sign on bronchography suggestive of alveolar-cell carcinoma. Bronchography in the six cases reported exhibited a characteristic appearance. The bronchi were extremely narrow, uniformly distributed, rigid, and filled rather than coated with the opaque medium, while the terminal bronchi and alveoli were free of contrast solution.

Observations on the properties and the bronchographic characteristics of Dionosil (aqueous suspension of the *n*-propyl ester of 3,5-diiodo-4-pyridone-N-acetic acid with the addition of sodium carboxymethylcellulose) were recorded by Norris and Stauffer.[31] This medium was employed in a series of 132 bronchograms, 87 with Aqueous Dionosil and 45 with Oily Dionosil. The only sequelae noted were elevation of temperature and occasional chest pain. Dionosil was found to be less irritating than the other aqueous media, and alveolar filling did not occur readily, and consequently fluoroscopic and roentgen observations could be done more leisurely. The bronchograms were characterized by uniform mucosal coating and excellent demonstration of the smaller peripheral bronchi. Elimination of the contrast substance was usually complete by the fourth day. The oily preparation of Dionosil offered the same advantages as the aqueous preparation, but a greater tendency toward alveolar filling followed and it took several days longer for elimination. Less topical anesthesia was necessary with Oily Dionosil. The local and systemic toxic effects were minor, and in five surgical specimens examined from 1 to 11 days following the instillation of the solution the changes consisted only of peribronchial cellular response, consisting chiefly of lymphocytes, plasma cells, and macrophages.

The transnasal endobronchial catheter method for bronchography was recommended by Crellin and his associates,[32] and no post-bronchographic complications occurred in the series of 503 cases reported. The preliminary sedation used was codeine and pentobarbital (Nembutal), and the anesthetic was cocaine. Iodized oil was preferred and the Stitz catheter proved satisfactory. Ideally five-lobe bronchial mapping is desirable, and this is best obtained by mapping one lung at a time. However, expedience often makes it necessary to outline the bronchi of both lungs at a single visit.

After testing a variety of new media for bronchography, Gudbjerg [33] concluded that a suspension of 5 gm. of sulfadiazine in 20 cc. of iodized oil was the best contrast medium so far available. No local irritation or toxic side-reactions were observed, and the contrast effect was good. Alveolar filling was rare provided the medium was not warmed before use, and complete elimination could be effected by coughing.

BRONCHOSPIROMETRY

Inada and associates [34] used the Carlens double lumen catheter in bronchospirometry and found the increase in oxygen consump-

tion in 10 healthy medical students to average 9.3% and the decrease in vital capacity 0.7%. In 10 patients with pulmonary tuberculosis, the figures were 11.3% and 5.2%, respectively. When the modified Norris-type flexible single lumen metal bronchoscope was used for bronchospirometry the figures were 33.6% and 7.2%, respectively. Bronchospirometry was also performed in the supine and both lateral positions in 10 normal persons. A slight increase in the absolute amount and a definite increase in the percentage of tidal air was noted in the under lung in the lateral position, along with a definite decrease in the percentage of reserve air. Total vital capacity decreased by an average of 7% while the subject was lying on the right side and 4% while lying on the left. Differential vital capacity of both the under and upper lungs showed a slight decrease when the patient was lying on the right side as compared with that found while he was supine. An increase in the amount and percentage of minute ventilation was noted in the under lung in the lateral position, along with a decrease in the ventilation equivalent, indicating increased efficiency. The total oxygen consumption showed no change in the right lateral position and an average decrease of 4% in the left lateral position as compared with the supine. In the sitting position tidal air, reserve air, vital capacity, minute ventilation, and total oxygen consumption all increased, indicating that this position was less resistant for respiration than the other positions.

Turner [35] studied by means of spirometric tracings a group of 40 patients who underwent pulmonary resection in childhood. The time interval between operation and testing varied from 3 months to 19 years, while the ages at operation ranged from 3 to 15 years. Reduction in vital capacity and maximum voluntary ventilatory capacity corresponded to the extent of resection and was more marked when bilateral resection had been done. Reduction in vital capacity was more evident in the inspiratory phase in all cases except those with residual pulmonary disease, where the reduction was more marked in the expiratory reserve phase. Pulmonary emphysema was more evident in those cases whose maximum breathing capacity was markedly reduced. Breathing reserve figures were within normal limits except in one instance. The age at operation was not a significant factor in the degree of resultant pulmonary function but rather the extent of pulmonary resection and consequent emphysema.

AEROSOL THERAPY

Gans [36] discussed two epidemics of acute bronchiolitis affecting mainly children 2 years old and under occurring in London during the winters of 1952-1953 and 1953-1954. In the first epidemic 41 children with bronchiolitis were treated with antibiotics and oxygen, with a mortality of 21.9%. In the second epidemic 27 children were treated in a similar manner but in the 7 most severely ill detergent aerosol vapors consisting of sodium lauryl sulfate and Alevaire (an alkylauryl polyether alcohol detergent) were used, with no deaths.

In the treatment of acute stenosing laryngitis in children, Leegaard and Lindman [37] considered temperate moist air essential. Their patients were placed in an approximately closed system consisting of a plastic box which would maintain constant control of the inspired air. The temperature of the air was not to exceed 24 C, and the relative humidity was maintained between 80%-90%. Along with oxygen a wetting agent, usually 0.1% solution of sodium lauryl sulfonate, was administered. This treatment was considered more effective than the formerly employed steam and, as a result, tracheotomy has been reduced and bronchoscopic aspiration has been rarely needed.

Aerosol inhalations of Alevaire were used in the treatment of 17 cases of bronchitis and bronchiectasis by Miller and associates.[38] Thick, yellow, solid sputum which had been expectorated with difficulty became thin and liquefied, with easier expectoration and decrease in volume.

An evaluation of aerosol trypsin therapy in 152 cases was made by Habeeb and coworkers.[39] Aerosol trypsin was found to be a satisfactory agent to liquefy mucus and was used with benefit in pulmonary tuberculosis, bronchiectasis, postoperative atelectasis, unresolved pneumonia, lung abscess, bronchial asthma, pulmonary emphysema, chronic bronchitis, and fibrocystic disease of the pancreas.

HEMOPTYSIS

In discussing hemoptysis, Pratt [40] emphasized the role of endoscopy in the investigation of its etiology. After inspection of the orifices of all of the bronchi secretion should be aspirated and biopsies done where possible. After thorough study it was found that the group of cases classified as idiopathic hemoptysis are significantly smaller than those in which exhaustive studies have not been made. In pulmonary tuberculosis, bronchoscopy may reveal bleeding from a tuberculous ulceration, and when the bleeding lobe can be located in cases of multicavitary disease collapse therapy can be applied to the proper lung segment. Occasionally a calcified hilar node can be observed or a broncholith may be located. In bronchiectasis the bleeding lobe can be identified accurately in most instances if bronchoscopy is performed at the proper time in the course of the disease. The endoscopist may be able to visualize the area from which bleeding and purulent discharge are arising, and in the event of mechanical obstruction by secretion bronchoscopy is of therapeutic value in cleansing the involved lobe. In a suppurative lung abscess the bronchoscopic picture is that of discharging fetid pus from a single lobe orifice and bleeding, if present, is from the same region. Marked inflammatory reaction is also observed about the subdivision of the bronchus, and the swelling may be so marked as to completely close the lumen. When an abscess occurs peripherally to obstruction caused by carcinoma, the bleeding is usually mild, but the endoscopist should be able to aid in the diagnosis, since carcinoma cells have been thrown off in the necrotic material and should be easily accessible to bronchoscopic aspiration and subsequent histologic study. In metastatic carcinoma, bronchoscopic search may locate the bleeding, which is usually confined to one bronchial orifice, although it occasionally is observed to arise from more than one segment of the lung. In chronic bronchitis with hemoptysis, bronchoscopic examination helps to localize the site of bleeding. When the mucous membrane is reddened and friable, bleeding may be observed from several widely separated areas. In the bleeding from cardiac lesions the source is usually diffuse and all that can be accomplished is aspiration and prevention of atelectasis. In bronchial adenoma the hemorrhage is usually sporadic and not profuse, and can be observed to originate from a single bronchial orifice. In pneumonia, the bronchoscopic picture is that of one or more bronchial orifices reddened and filled with crusty, purulent discharge.

The value of determination of the exact source of bleeding by bronchoscopy in cases of hemoptysis was pointed out by Carr and Douglass.[41] The examination was advised before the bleeding has ceased, and the endoscopist may contribute to the diagnosis by finding a foreign body, bronchial ulcer, stricture, or broncholith. In other cases benign or malignant tumors may be found.

FOREIGN BODIES IN THE BRONCHUS

Triangulation roentgenoscopy was described by Dorenbusch [42] as a method of removing opaque foreign bodies beyond bronchoscopic vision. Since fluoroscopic direction is needed, the single screen of this apparatus acts as a simplification of the biplane fluoroscope. Descriptions of illustrative cases proved the successfulness of this method of extraction.

In reporting 20 cases of intrabronchial foreign bodies, McManis and Windsor [43] emphasized that failure to obtain a history of inhalation does not exclude this possibility. A history of recent cough with hemop-

tysis and a shadow on the roentgenogram in the right cardiophrenic angle suggest foreign body.

Rao [44] reported an unusual foreign body in the respiratory tract in which the presenting symptom was severe dyspnea. The foreign body consisted of a fish approximately 4 in. in length, which had been aspirated by a 14-year-old boy and lodged in the left bronchus. Marked density over the entire left lung field was present on the roentgenogram. Before it was removed at bronchoscopy, it was noted that while the fish was lodged head down in the left bronchus the tail of the fish was protruding over the bifurcation of the trachea and flapping in and out of the orifice of the right bronchus, impeding entry of air into that lung but not completely occluding this opening. The potential dangerous nature of the foreign body was established by this finding.

TRAUMA OF BRONCHUS

Sale [45] reported two cases of fracture of the bronchus secondary to crush injuries of the chest. In one case bronchoscopy performed approximately one month after the injury revealed edema and narrowing of the right main bronchus, with partially organized blood clot in the lumen completely occluding the right middle and lower lobe orifices. In the other case atelectasis of the left lung developed, and when bronchoscopy was performed approximately five years later the left main bronchial opening was not seen but was thought to be a tiny opening to the left of a widely dilated right main bronchus.

Dalgleish and associates [46] presented a case of traumatic rupture of the right main bronchus with complete bronchial occlusion. Bronchoscopy performed soon after the trauma revealed granulation tissue on the posterior and lateral surfaces of the right main bronchus, with occlusion and the presence of a large plug of fibrous exudate. When the bronchoscopic examination was repeated about six weeks later, there was found complete occlusion of the right main bronchus and at the bottom of the sac a small area of unepithelized granulation tissue was present.

ACUTE LARYNGOTRACHEOBRONCHITIS

Turner [47] described three essentials in the treatment of acute laryngotracheobronchitis: moist air, sedation, and antibiotics. While the indication for tracheotomy varies with each case, the operation was recommended in any child who failed to show a satisfactory response to medical management after a maximum observation period of two hours. Constant observation and reassurance provided by a competent nurse familiar with the danger signals was an integral part of the treatment.

Bradshaw [48] emphasized the importance of bronchoscopy to obtain cultures and remove obstructing and tenacious secretions. Its use in the diagnosis was considered imperative, since the bronchoscopic appearance was pathognomonic. In the case reported tracheotomy was performed and a granuloma developed in the trachea at the site of the tracheostomy after extubation. Respiratory obstruction developed, so that a second tracheotomy was necessary, and removal of the granuloma was accomplished by spontaneous expulsion by the patient.

Carabelli [49] advocated early therapy of acute suppurative segmental bronchopneumonitis which was obstructive in type with endobronchial penicillin. Endobronchial instillation of oleaginous penicillin directly into the segmental bronchus involved was performed in 10 patients, with marked improvement. The method was also recommended for poor-risk patients with chronic suppurative bronchopneumonitis prior to definitive surgery.

INTUBATION IN PULMONARY EDEMA

Webb and Campbell [50] utilized the indwelling endotracheal tube to aspirate fluid in cases of pulmonary edema and to administer oxygen under constant positive pressure. This method was used in four patients during or immediately after pneumonectomy and proved successful. It was considered applicable to most cases of pulmonary edema, irrespective of the medical or surgical etiol-

ogy, to remove the accumulating fluid itself and thus help prevent the lethal factor in pulmonary edema.

MEDIASTINAL GRANULOMA

Brunkel and co-workers [51] described 16 cases of mediastinal granuloma. In one case in which the detailed description was given, bronchoscopy revealed that the lumen of the right main bronchus was about one-fifth of its normal diameter and that of the left was reduced to about one-third. This patient had endoscopic dilation with only temporary relief, so that surgical excision was performed.

BRONCHIAL OBSTRUCTION

One hundred patients with bronchial obstruction in fifty of whom bronchoscopy was negative were studied by Johnston and associates.[52] In the cases in which the bronchoscopic findings were considered normal by three independent observers there were 6 with bronchial carcinoma, 14 with pulmonary tuberculosis, and 8 with pneumonia. A cough which had altered in character, a localized wheeze, a local reduction in breath sounds, and localized rhonchi were commonly present and suggestive of bronchial obstruction.

Douglass [53] discussed the use of bronchoscopy in benign bronchial obstruction. Various phases of foreign-body diagnosis and treatment, benign neoplasms, broncholithiasis, bronchostenosis, and atelectasis were discussed.

ATELECTASIS

Bailie and Scott [54] reported a case of massive lung collapse following tonsillectomy and adenoidectomy. In this case the child had a sinus infection before admission to the hospital and was febrile at the time of operation, which was performed under a general anesthetic. Bilateral antral washing was performed prior to tonsillectomy and adenoidectomy, and 24 hours later signs of massive lung collapse developed. At bronchoscopy a small quantity of sticky mucopus which was slightly blood-stained was aspirated from the upper part of the left main bronchus. The lower part of the bronchus was free from secretion or other obstruction. This finding suggested the possibility that the secretion had been aspirated soon after operation and subsequently formed a block with the resulting atelectasis. After removal prompt recovery occurred.

BRONCHOLITHIASIS

A case of broncholithiasis occurring in active tuberculosis was reported by Walsh.[55]

FUNGUS DISEASES OF LUNG

Indicating that pulmonary blastomycosis is being recognized more frequently, Acree and associates [56] reported six cases. In one case there was a 3 mm. endobronchial mass, but in the others the bronchi were free. On the basis of three years' experience, 2-hydroxystilbamidine appeared to be effective and nontoxic as a therapeutic agent. In one case lung resection was required following control of the active disease by the above therapy. After the correct diagnosis has been established 2-hydroxystilbamidine should be administered in every case prior to operation. In the event that pulmonary resection or biopsy established the diagnosis of pulmonary blastomycosis prompt therapy with a diamidine was used.

Sealy and his associates [57] presented two cases of pulmonary blastomycosis that recovered after deliberate surgical extirpation of the infected lung. The use of stilbamidine in the therapy of the generalized form was successful in eight cases. Recovery occurred and there was no relapse, although the follow-up period was short. In six of the eight cases a complication developed in the nature of trigeminal neuropathy which was associated with the administration of the drug. In certain selective cases where only the lungs are involved and there is adequate immunity, as indicated by a positive skin test to blastomycin, resection alone can be considered, and stilbamidine can be saved for use if complications develop. Even though the infection is controlled by stilbamidine, pulmonary resection may have to be done at a later date if extensive lung destruction occurs. Vaccine therapy was advocated

to desensitize the patient before surgery so that there would not occur a hypersensitive reaction with a postoperative spread.

The characteristics of bronchial aspergilloma were defined by Pesle and Monod.[59] This pulmonary mycelium tumor due to the Aspergillus presented a characteristic roentgen appearance in the nine cases reported. Hemoptysis was usually present but tubercle bacilli were absent. Bronchoscopy either revealed no abnormality or edema about the involved bronchial orifice.

Two cases of the relatively rare fungus disease of cryptococcosis were described by Poppe,[59] in both of which the bronchoscopic findings were negative. The diagnosis was not made until exploratory thoracotomy due to the fact that the fungi were encapsulated and not available for positive laboratory test preoperatively either by studies of the sputum or bronchoscopic aspiration.

Stadler and his associates [60] reported a case of pulmonary nocardiosis with multiple metastatic abscesses in a child in which the diagnosis was not made prior to death because the child became too ill for bronchoscopy. The question was raised as to whether bronchoscopy should be done routinely in any patient with an intrapulmonary process that does not rapidly respond to antibiotic therapy when sputum is not available, either because it is not being produced or because the patient cannot cooperate. At bronchoscopy, if a local lesion is not found at biopsy irrigation of the proper bronchus with saline solution can be used for bacteriological study.

PULMONARY SARCOIDOSIS

The value of bronchoscopy in the diagnosis of pulmonary sarcoidosis lies in eliminating other conditions, according to Hodgson and Woolner.[61] Occasionally, involvement of the bronchial wall with obstruction of the bronchi or trachea occurs, and the diagnosis may be established by bronchial biopsy in these rare instances.

PRIMARY AMYLOIDOSIS

A case of primary amyloidosis in the lower respiratory tract was reported by Bolstad.[62] On bronchoscopy a large tumor mass was found arising from the anterior wall of the trachea at a point approximately 2 in. above the carina and extending distally to invade both main bronchi. The left main bronchus was markedly narrowed by the growth, and large amounts of tissue were removed and reported histologically as amyloid deposits. Repeated bronchoscopies were performed, and at first electrocauterization was performed after tissue removal. Later the tissue could be peeled off in large pieces by the lip of the bronchoscope. The last bronchoscopy performed about two years after the original lesion was found revealed gradual diminution in the caliber of the trachea and both main bronchi, with some regrowth in the trachea, although not as marked as originally observed and not to a degree to produce symptoms.

BRONCHIECTASIS

In the diagnosis of bronchiectasis, bronchoscopic examination is necessary to exclude the presence of obstructive lesions within the bronchial tree. As indicated by Olsen and Clagett,[63] bronchoscopic aspiration and lavage have very little value in providing adequate drainage from the tracheobronchial tree.

PULMONARY ABSCESS

Gray and Schmidt [64] advocated bronchoscopic examination in every patient with lung abscess to exclude the possibility of a bronchial obstructing lesion and to localize the segment of lung involved. Since at least 10% of lung abscesses are secondary to bronchogenic carcinoma the need for visualization of the tracheobronchial tree is evident, and at the same time bronchial secretions can be obtained for cytologic study. In addition cultures to determine the pyogenic bacteria and their resistance to the various antibiotics are advantageous.

Bronchoscopy proved to be an integral part of both diagnosis and conservative treatment of pulmonary abscess, as demonstrated by Waterman and Domm [65] in 401 cases. The high incidence of neoplasm in the group made the procedure imperative, but, in addi-

tion, segmental localization of the abscess, evaluation of the bronchial reaction, examination for foreign body, and procurement of bronchial secretion for bacteriological study proved valuable. Therapeutically the early use of bronchoscopy was found to frequently abort a lung abscess in the formative stage or markedly improve the more advanced cases by promoting bronchial drainage. In 32.1% of the cases bronchoscopy was performed more than once.

Bronchoscopy was considered essential in the diagnosis of nonspecific lung abscess by Fox Jr. and associates.[66] Bronchoscopy was used to rule out tumors, foreign bodies, and other intrabronchial lesions. Temporary therapeutic value resulted from aspiration of purulent material, and in one case where segmental bronchial constriction was present bronchial dilatation at intervals helped to obtain a cure. It was thought that no case not cured by antibiotic treatment would have been cured by bronchoscopic aspiration and local antibiotic instillation.

In the treatment of lung abscesses, Metras and Charpin[67] found that accurate bronchography using preferably a water-soluble contrast medium gave valuable information concerning the size and exact location of the initial lesion as well as the degree of anatomic healing. The contrast medium was injected directly into the diseased lobe or segment by means of a catheter. By this means adequate localized antibiotic instillations were made possible, and it also contributed to the correct interpretation of the final results where residual cavities were frequently found.

CYSTIC LESIONS OF BRONCHUS

A case of tracheobronchial cyst occurring in the neck was reported by Spencer and Finlay-Jones.[68]

Williams[69] reported a bronchogenic cyst in an infant who had persistent wheezing and spasmodic cough since birth that caused emphysema of the left lung and mediastinal displacement due to left bronchial obstruction.

Bruwer and his co-workers[70] reported five cases of intralobar bronchopulmonary sequestration comprised of a cystic lesion in a lower lobe associated with a large anomalous artery arising directly from the lower thoracic or upper abdominal part of the aorta. The bronchoscopic findings were not characteristic and revealed either an apparently normal bronchial tree or purulent secretions coming from the lower lobe bronchus.

PAPILLOMA OF BRONCHUS

A case of true papilloma of the bronchus was reported by Ashmore.[71] The patient experienced hemoptysis, cough, and expectoration of sputum. On bronchoscopy a mass of pink tissue was seen in the right lower lobe bronchus, and removed tissue was reported as normal bronchial mucosa. In spite of this, thoracotomy was performed, and when the bronchus was opened the tumor was found to be attached to the bronchial wall at the junction of the lateral and anterior basal subdivisions. The diagnosis of normal bronchial mucosa obtained on the biopsy specimen could be explained on the basis of the fact that the mucosa was heaped up in many frond-like projections and was columnar ciliated in type with two or three layers' thickness.

McCart[72] reported a case of multiple papillomata of the larynx in a 10-year-old boy who received 9000 r units by radiation therapy, without beneficial result. Five years later implants were found in the trachea and bronchi which showed malignant change, and the patient eventually died of massive pulmonary bleeding.

BENIGN TUMORS OF LUNG

Thomas[73] reported 57 benign tumors of the lung, with 41 bronchial adenomas, 10 hamartomas, 4 vascular tumors, and 2 endobronchial fibromas. Of the bronchial adenomas endoscopic treatment was used in only two, and in both of these recurrence developed, necessitating surgical treatment. The importance of bronchoscopy for early diagnosis in cases with repeated hemoptysis and persistence of cough, wheeze, or repeated attacks of infection was emphasized. The two cases of endobronchial fibromas ex-

hibited a lobulated mass within the lumen of the dilated bronchus which was very vascular and bled easily.

Two cases of endobronchial hamartoma were reported by Young and associates.[74] In both cases, bronchoscopy revealed a reddish polypoid tumor, but on biopsy no diagnosis could be made. Respiratory epithelium with some squamous metaplasia was obtained in one case and fragments of respiratory epithelium in the other. Because of the presence of the tumor, lobectomy was performed.

Edwards [75] reported a case of lipoma of the bronchus in a 76-year-old man that produced bronchial obstruction and bronchopneumonia and led to death.

BRONCHIAL ADENOMA

Moersch and Harrington [76] considered bronchoscopy to be the most valuable aid in the diagnosis of bronchial adenoma. The majority of the adenomas originated in the large-stem bronchi and were readily accessible to bronchoscopic visualization and tissue removal for histologic study. Of 84 cases the lesion could be visualized endoscopically in 78, and in 75 of the 78 cases tissue was obtained for microscopic examination. No rule could be laid down for the uniform treatment of patients with bronchial adenoma, but the opinion was expressed that in the pedunculated adenoma with a narrow base attached to the bronchial wall and within bronchoscopic vision the most satisfactory treatment was endoscopic removal. Bronchoscopic treatment was also advised in patients of advanced years and those with physical disability in whom thoracotomy and subsequent pneumonectomy would be dangerous. After endoscopic treatment was employed, it was followed by bronchoscopy at intervals to be certain that the tumor had not recurred. One case was cited in which recurrence of the tumor occurred more than 10 years after its original endoscopic removal. The former practice of implantation of radon seeds into the base of the adenoma following removal of the tumor through the bronchoscope has been discontinued because of the resulting bronchial stricture from destruction of the bronchial cartilage at the site of the radon implantation.

In 70 cases of bronchial adenoma, Carlens and his associates [77] described the characteristic bronchoscopic picture as a red, round, polypoid tumor usually filling the bronchial lumen. In some cases, fine lobulations and a yellowish color were observed, but the distinguishing characteristic from carcinoma was the intact mucous membrane. In adenoma the tumor was usually not fixed, as in carcinoma, and not infrequently pus was seen between the tumor and the occluded bronchus, while carcinoma usually exhibited a dull ulcerated surface with no purulent secretion. This was thought to be due to the more rapid growth of the malignancy, so that peripheral suppurative changes did not have time to develop, as in the slower-growing adenoma. A marked bleeding tendency was noted in adenoma. In 66 of the 70 cases, the tumor was visible and biopsy could be obtained. Occasionally the microscopic appearance was not typical, particularly in the trachea and larger bronchi, where the tumor appeared as a flat infiltration of the wall. From a diagnostic point of view, bronchoscopy is one of the most valuable aids, but it is not as important from a therapeutic standpoint. Since many of the tumors have extrabronchial extension with possible malignancy and secondary, often irreversible, changes in the lung, thoracotomy has become the method of choice. In addition, after bronchoscopic treatment, it is never definitely known whether the tumor has been removed entirely. A slighter risk is the danger of cicatricial stenosis developing in the bronchus secondary to removal and coagulation. Bronchoscopic treatment was reserved for cases in which there was a polypoid tumor with a thin pedicle and no secondary bronchial suppuration and for those so situated either in the trachea or at the carinal level that any other surgical procedure would be dangerous. Bronchoscopic treatment may be indicated in patients who are poor risks for surgical therapy. In the cases treated

by bronchoscopic methods, coagulation diathermy, preceded in some cases by injection of a sclerosing agent directly into the tumor, was employed. In the patients treated bronchoscopically three were alive after periods ranging from three to seven years with very slight pulmonary symptoms despite persistent atelectasis and known remaining tumor. There may be additional value in the bronchoscopic coagulation of the tumor prior to operation, so that removal of the intrabronchial portion allows drainage peripherally and elimination of retained secretion.

Soutter [78] reported 53 patients with bronchial adenoma diagnosed or treated by bronchoscopic means during a 31-year period. The follow-up in this group of cases was quite complete. Thirteen of the patients with carcinoid adenoma died. Only eight of these patients were examined at autopsy, but the causes of death for the remaining five were known and apparently none died of the disease. Two of the patients with cylindromas died, both of their disease. Forty-one patients are living and as yet there is no evidence of local or distant metastases in any. Three patients still have their adenomas, and, in these, symptoms are still present. In general bronchoscopic observation and biopsy were invaluable in establishing the diagnosis. The cylindromas were nearly always visible on bronchoscopy, but occasionally the carcinoid tumors were too peripheral to be seen. Twenty patients with carcinoid adenoma were treated by transbronchoscopic resection, with four subsequent deaths. An average of 15 procedures over a three and a half year period was necessary in treating this group. The author was of the opinion that in patients who are good surgical risks transthoracic resection is superior to endoscopic removal. In treatment, the use of bronchoscopic aspiration and resection for relieving the symptoms of patients who cannot survive surgical resection is justified, but in all other cases external surgical treatment is advocated.

In adenomas of the trachea and bronchi, Soutter and his associates [79] identified 35 carcinoid adenomas and 2 cylindromas by bronchoscopic examination and biopsy prior to operation. The histologic diagnosis was ultimately established by bronchoscopic biopsy in 46 of the 60 cases. Radical surgery was avoided in three instances because preoperative bronchoscopic study indicated that the tumors were carcinoid adenomas. There were five tumors resected that were too peripheral to be seen at bronchoscopy. The cylindroma was often found to be so extensive as to be inoperable, tended to recur, and had distant as well as local metastases. Although it grew more slowly and metastasized less frequently than epidermoid carcinoma, it proved to be ultimately fatal in a high proportion of cases. On the other hand, the carcinoid adenoma, while histologically displaying evidence of malignant potential, behaved clinically in a fairly innocuous fashion. In this group about half of the carcinoid adenomas showed local invasive qualities, and in one invasion of lymphatic channels was observed, but none proved to be inoperable. There were no distant metastases, and limited pulmonary resection could be employed in this group with satisfactory results.

Davy and Hardy [80] considered the natural history of bronchial adenoma to metastasize, and since there is no way in which clinical or histologic study can show the degree of malignancy, there is no place for endoscopic treatment. After biopsy is performed bronchoscopically, radical operation is recommended except in patients markedly debilitated by associated obstruction and infection.

An unusual case of bronchial adenoma was recorded by Weller [81] in which the diagnosis was made bronchoscopically only after collapse of the patient from hemorrhage into the pleural cavity secondary to rupture of the right middle lobe from bleeding behind the tumor.

Roberts [82] reported a case of bronchial adenoma in a 6-year-old girl producing obstruction of the left lower lobe bronchus.

Ward and his associates [83] reported a case of bronchial adenoma in a 7-year-old boy. On bronchoscopy the tumor was visualized in the left main bronchus, and biopsy was reported as a bronchial adenoma.

PULMONARY ADENOMATOSIS

Five cases of pulmonary alveolar adenomatosis were recorded by Lell and Crane,[84] who stated that the disease is being recognized clinically more frequently in spite of its multiple manifestations. Four of the five cases reported were in women, in contrast to the high incidence of bronchogenic carcinoma in the male. Although considerable histologic similarity was found between the disease in man and that in sheep, no true relationship between these two diseases was demonstrated. Because of the bizarre pattern which this lesion may manifest during its progression, very little can be gained from the patient's symptoms or clinical course during the early inception of the disease and the diagnosis has to be made by histologic examination. Little information can be gained by bronchoscopy in the usual case, but the aspirated secretion can be examined for tubercle bacilli and cancer cells and if none are found the lesion may be suspected. The final histologic diagnosis was made on either the surgically excised specimen or the specimen obtained at autopsy.

Farber and his co-workers [85] reported four cases of pulmonary adenomatosis and pointed out the value of cytologic study, with particular attention to nuclear appearances in establishing the diagnosis.

ALVEOLAR-CELL TUMORS

Kirklin and McDonald [86] reported that bronchoscopic examination should be done in all patients with suspected alveolar-cell tumor even though an intrabronchial lesion is rarely seen. Among 14 cases only one biopsy disclosed positive evidence of carcinoma, but in 9 of the 14 cases malignant cells were found in either the sputum or the bronchial washings or in both.

BRONCHOGENIC CARCINOMA

In analyzing bronchogenic carcinoma in 201 proved cases, Steele [87] considered bronchoscopy to be of value in establishing the diagnosis by visualization and biopsy of the lesion and by permitting removal of bronchial secretions for cytologic examination. It was also found to be an aid in determining operability based on changes observed in the tracheobronchial tree. The bronchoscopic picture of bronchogenic carcinoma varied greatly from a soft, red, nodular lesion with polypoid appearances to stenotic changes in the lobar or main bronchi preventing visualization of the neoplasm directly. Even though no ulceration was present biopsy was advisable from the area of stenosis because frequently infiltration by carcinoma could be demonstrated on tissue section. Other changes noted were fixation and rigidity of the carina, tracheal compression or displacement, bronchial compression or distortion, and recurrent nerve paralysis. In this series the diagnosis was made by bronchoscopic biopsy in 41.2% of the patients subsequently proved to have bronchogenic carcinoma, and in 39.8% bronchoscopy demonstrated anatomical and pathologic changes typical of bronchogenic carcinoma. Cytologic study of bronchial secretions was done in 39 patients, in 36% of whom malignant cells were demonstrated. In 15.4% of all patients bronchoscopy and cytology were negative for signs of malignancy.

Moersch and his associates [88] discussed the value of bronchoscopy in the diagnosis of bronchogenic carcinoma. In a recent study of a group of 93 cases of bronchogenic carcinoma in which bronchoscopy was done, positive results from biopsy were obtained in only 38 instances (41%). This was in contrast to previous studies, in which the number of positive biopsies was 63%. The reason for the difference in the percentage of positive results on biopsy was due in part to the fact that a number of patients are now undergoing surgical exploration for unidentified pulmonary tumors which prove

to be carcinoma when there is no large mass in the bronchial tree. Bronchoscopy is not only valuable in diagnosis but may assist in the exact location of the tumor. Cytologic examination of sputum and bronchial secretions have proved to be highly effective in the diagnosis. In the small-cell carcinoma, microscopic examination of tissue removed at the time of bronchoscopy revealed carcinoma in 76.5%, while cytologic examination of sputum and bronchial secretions disclosed malignant cells in 93.5%. In the adenocarcinoma group, biopsy was reported as positive in only 22.8%, while cytologic examinations gave a positive diagnosis in 48.8%. In the large-cell bronchogenic carcinoma, malignancy was diagnosed on the biopsy specimen in 45.4% and positive reports from cytologic examination were reported in 71.8%. In squamous-cell carcinoma, 80% could be diagnosed positively by biopsy, while the results of cytologic examination were positive in 72.3%.

In 403 cases of carcinoma of the lung, Boyd and co-workers [89] made a positive diagnosis by bronchoscopic biopsy in 42.3%. Cytologic study was positive in 40% of the proved cases in which it was employed. Indirect evidence of carcinoma by bronchoscopic examination was found in 77.4%.

Five cases of squamous-cell carcinoma of the major bronchi in which there was no apparent gross tumor were described by Wierman and his associates.[90] One of the lesions was a carcinoma in situ, while the others were small, superficially invasive malignancies with surrounding carcinoma in situ. The malignant epithelium was observed bronchoscopically to grow in a centrifugal manner and by obliterating the normal longitudinal furrows of the mucosa impart a roughened or granular appearance. The diagnosis was made by bronchoscopic biopsy in three cases in which roughened areas were detected, and in the remaining cases secretion aspirated bronchoscopically yielded malignant cells. All of the patients were amenable to surgical resection, and in none were lymph nodes involved.

In carcinoma of the bronchus with negative x-ray findings, as illustrated by three cases, Goldman and Freeman [91] thought that endoscopic diagnostic procedures were not performed sufficiently soon in symptomatic patients with evidences of bronchial irritation. Although the incidence of carcinoma of the bronchus in the presence of negative x-rays is small such lesions do exist, and if they could be recognized early chances of cure would be enhanced. When the precise source of bronchorrhea can be visualized, secretion for cytological study can be obtained and this may contribute to the diagnosis of the disease at an earlier stage. If roentgen studies were performed in every case in which symptoms of bronchial irritation were present, even for a few weeks, and included numerous views with inspiratory and expiratory films, indirect information leading to the suspicion of the presence of bronchogenic carcinoma could be obtained more frequently, and if these cases were followed up by diagnostic bronchoscopy, earlier diagnosis might be made.

Venous angiocardiography was performed by Slesser and his co-workers [92] on 31 patients with bronchial neoplasm, all of whom were operable on clinical and bronchoscopic findings. Three patients with deformity of the superior vena cava and eight patients with deformity of the main pulmonary artery on angiocardiography were found to be inoperable at thoracotomy. This procedure would seem to have merit in determination of operability of bronchogenic carcinoma.

Jefferson and associates [93] recorded the development of bronchial carcinoma in two cases of sarcoidosis.

Blades and McCorkle [94] reported the only known instance of a case of spontaneous regression of bronchogenic carcinoma. Despite evidence of metastasis to the skull, the patient remained well more than five years after the original diagnosis of bronchogenic carcinoma, confirmed by microscopic section, was made. There was almost complete disappearance of the lesion in the right lung during this time. Tissue was secured at

thoracotomy at the original operation, when the lesion was considered inoperable and the chest closed. No explanation was found for the regression of the lung cancer.

MECHANISM OF SWALLOWING

Podvinec [95] described the normal act of swallowing as consisting of three phases, namely, compression, transport, and emptying. On swallowing a portion of air preceded the bolus, and the compression produced by the air bubble appeared to be a factor in the swallowing mechanism. The compression chamber formed by the gas bubble was necessary to project the bolus of food through the esophagus and enabled the esophagus to better propel the bolus. The air bubble itself was unable to carry out the transport of the bolus, and this had to be done by tonic contraction of the esophageal wall. It was thought that the importance of the compressed air bubble together with the three physiological narrowings in the esophagus explained many changes in the swallowing mechanism, such as that occurring in lodgment of a foreign body where the compressed air which precedes the swallowing of the foreign body escapes slowly around the sides of the object.

Dornhorst and his co-workers [96] studied the behavior of the normal esophagus and cardia using simultaneous radiography and intraesophageal pressure measurements. It was found that from the point of view of function the cardia was a very localized region extending over not more than 5 mm. This region had the characteristic of a valve—namely, very little resistance was necessary for forward passage but retrograde flow was resisted in spite of great pressure. The mechanism appeared to be intrinsic in the neighborhood of the anatomical cardia and to be independent of external visible folding or kinking. No evidence was found to indicate that the diaphragm plays a role in the occlusion of the lower end of the esophagus and cardia.

PHARYNGOESOPHAGEAL DIVERTICULUM

Lahey and Warren [97] presented their surgical experience with 365 patients with pharyngoesophageal pulsion diverticula and 9 patients with epiphrenic pulsion diverticula. In the roentgen diagnosis of pharyngoesophageal pulsion diverticulum, separation from dilatation of the esophagus above an esophageal web or stenosis was discussed. The advantage of the two-stage operation advocated by the authors was presented together with complications which developed in the follow-up study of 250 of the patients operated on. The different stages of the development of a pharyngoesophageal diverticulum were arbitrarily divided into (1) initial stage, in which no sac exists but only the first bulge of mucosa and submucosa through the triangular weak point at the pharyngoesophageal junction occurs; (2) small but fully formed diverticulum with a definite neck and sac; (3) fully developed diverticulum in which there are symptoms of obstruction and descent of food into the esophagus is impaired, with degrees of inanition due to inadequate food intake. Attention was called to the possibility of a malignancy in the sac when there was an irregularity in the outline of the barium-filled sac. A warning was given regarding bouginage in the presence of a diverticulum, for such may result in perforation of the end of the sac, with resulting mediastinitis. Most recurrences were considered to be due to incomplete dissection of the neck of the sac and therefore incomplete removal of the sac.

LeJeune [98] pointed out that pharyngoesophageal diverticula are being recognized with increasing frequency. Although the diagnosis is easily suspected from the symptoms, it can be definitely established by barium visualization of the esophagus. Esophagoscopy is needed to verify the roentgenographic observations and rule out the possibility of stricture from malignancy. Esophagoscopy is not easy because the location, size, and pressure of the diverticulum push the esophageal opening anteriorly, making it difficult to find and visualize the esophageal opening. Since the mouth of the diverticulum remains open at all times, food and liquid collect in the sac rather than pass

into the esophagus. Diverticulectomy in one stage under general anesthesia was performed in 41 patients, and in 36 of these the results were successful. Complications developed in five patients. These consisted of paralysis of the recurrent laryngeal nerve, persistent fistula requiring reoperation, and stricture necessitating prolonged dilatation. The two cases of stricture were due to removal of too much pharyngoesophageal mucosa, which could have been avoided by insertion of an esophagoscope before the mucosal closure. Since employing routine esophagoscopy no strictures have developed.

A pulsion diverticulum of the hypopharynx with multilocular bilobed structure and a single opening into the hypopharynx was described by Jesberg.[99] On esophagoscopy a single, moderate-sized stoma was found more to the left than the right, and within a centimeter of the stoma two separate sacs were present, one to the right and one to the left, separated by a carina-like septum in the anteroposterior axis. The left sac was somewhat larger than the right, and the subdiverticular esophagus could not be located. At operation neither nerve nor blood vessel was found in the region of the bifurcation of the diverticulum to account for the variation in shape. The stoma communicated with the hypopharynx through the left posterolateral wall between the fibers of the cricopharyngeus muscle. The right side of the sac was lodged between the trachea and esophagus and extended into the right side of the neck, with compression of the trachea to about 60% of its anteroposterior diameter. Successful removal was accomplished by combined one-stage diverticulectomy.

A case in which instrumental damage to the hypopharynx resulted in the development of a pulsion diverticulum was described by Hamberger and Larsson.[100] On esophagoscopy, performed for lodgment of a fish bone in the hypopharynx, perforation occurred, and after healing of the mediastinitis and fistula a diverticulum developed at the site of perforation.

ACQUIRED ESOPHAGOBRONCHIAL FISTULA

Two cases of acquired nonmalignant esophagotracheobronchial fistula were reported by F. A. Hughes Jr. and J. R. Fox Jr.[101] In one case the cause was due to a nonpenetrating traumatic injury. No cause could be found in the second case other than persistent vomiting, and the outcome was fatal following surgical closure of the fistula. There was ulceration at the fistula site which was not recognized preoperatively and might have contraindicated surgery. The ulceration might have been found if an endoscopic examination of the fistula from both sides had been performed. The authors recognized this fact and argued for careful examination, preferably with optical equipment.

FOREIGN BODIES IN THE ESOPHAGUS

Harlowe[102] removed a porcupine quill more than 25 mm. in length from the esophagus which had apparently lodged there after the ingestion of hamburger made of deer and pork meat. The advantage of a thin, barium, lateral esophageal roentgen film to show the narrow, nonopaque foreign body was pointed out.

Debord[103] reported the successful removal of an open safety pin from the esophagus of a 5-week-old infant. This was the youngest case that the author could find in the literature.

PERFORATION OF THE ESOPHAGUS

A case of perforation of the esophagus, mediastinitis, and subsequent rupture of the aorta by a piece of fly-wire screening presumably ingested with sausage was described by Birrell and Syme.[104]

Ehrenpreis[105] reported a simple method for repair of a perforation in the cervical esophagus of a newborn infant. At operation, a defect in the esophageal wall about 3 cm. in length and covering more than half of the circumference was found. Since it was impossible to resect this area and perform an esophageal anastomosis a catheter was

inserted through the nose and esophagus into the stomach. The catheter was left in place until complete healing occurred around the tube, and roentgen examination revealed no deformities, with normal passage of barium through the esophagus. Subsequent esophagoscopy revealed the esophagus to be dilated, and on the left side of the upper end of the esophagus at the site of the previous opening some streaks of scar tissue were visible, but other than this the pattern was normal and there was no evidence of stenosis or stricture formation.

SUPERFICIAL ESOPHAGITIS DISSECANS

In a case of esophagitis dissecans superficialis, Beck [106] could find no satisfactory explanation for this rare, benign condition. The lesion was characterized by extensive dissection of the squamous epithelium of the esophagus from the underlying corium in the form of a tubular cast, which in this case measured 30 cm. in length and 2.5 cm. in diameter with a grayish-white, thin, translucent wall.

ESOPHAGITIS

Benedict and Gillespie [107] studied 100 patients with peptic stenosis of the esophagus and concluded that this condition was due to abnormally prolonged contact of gastric juice with the region of the esophagus above the cardia. Abnormal gastric juice in the lower esophagus followed esophageal hiatal hernia of the sliding type, regurgitation from relaxation of the cardia, and from excessive vomiting. Esophagitis was observed in all the 100 cases studied, and in 42 ulceration was present. In view of these findings it was thought desirable to repair all hiatal hernias which were producing symptoms and did not respond to medical measures. Bouginage using a previously swallowed thread as a guide proved to be satisfactory in most cases of peptic stenosis. It was combined with dietetic treatment, antispasmodics, and antacids. The indications for surgery were failure of bouginage, severe hemorrhage, and perforation.

In peptic esophagitis, Carver and Sealy [108] found that the majority of cases were associated with hiatus hernia. Success in preventing stenosis at the site of the esophagitis depended upon early diagnosis of peptic esophagitis and repair of the hiatus hernia before esophageal shortening developed. Most cases of peptic esophagitis can be controlled by medical means and stenosis prevented. Repair of the hiatus hernia is indicated in the presence of esophagitis which fails to respond completely to medical management. In patients with hiatus hernia and complaints of substernal pain, surgical treatment should be considered, for all too frequently these patients return several years later with dysphagia, esophageal shortening, and stenosis—too late for uncomplicated hiatus hernia repair. When the symptoms can be controlled by dilatation using a string as a guide, relief can be secured in many patients in which the esophagitis is complicated by chronic ulceration and stricture formation. In arriving at the diagnosis esophagoscopy is essential to rule out carcinoma. In addition, it establishes the presence of inflammation and ulceration. In acute cases the mucous membrane is fiery red with edema and friability of the tissue, while the chronic ulcer is characterized by a whitish-yellow exudate over a flat base with mucosal congestion around the edges. In the 130 patients with peptic esophagitis, hiatal hernia was found to be the cause of hiatus sphincter incompetency in 76%. Of 101 patients esophagoscoped, 82 were found to have evidence of acute or chronic ulceration.

Palmer [109] studied 100 patients with an esophagoscopic or transesophagoscopic biopsy diagnosis of subacute corrosive esophagitis. Sixty-four patients were examined more than once, and fourteen were reexamined at intervals over a seven- to twelve-month period. The three features of the endoscopic picture that were regularly found were hyperemia, erosions, and exudate. In some patients a swallow of fluorescein was given prior to the esophagoscopy to stain the eroded areas. Nineteen patients were believed to be bleeding from the esophagitis, and in twelve

examined during active hematemesis the bleeding was definitely found in the area of esophagitis in eleven instances, while esophageal ulcer was present in seven patients. In treatment medications varying from simple local therapy with bismuth compounds to strict ulcer regimen were compared with no medical treatment, and the results indicated improvement, both subjectively and objectively, in every group, indicating that esophagitis was a self-limiting disease. Acid-peptic corrosion was not unreservedly accepted as the cause of esophagitis in this series.

Schmidt [110] reviewed 170 patients with regurgitant ulceration at the esophagogastric junction and found 158 hiatal hernias, suggesting that the loss of sphincteric action at the cardia may have been the causative factor in the ulceration. The results of medical treatment were excellent or good in 64%; in the 19 cases operated upon the results were practically identical. Surgical procedures performed for cardiospasm and benign strictures often led to incompetency of the cardia.

In 100 patients with chest pain, McHardy [111] found regurgitant esophagitis responsible for most of the symptoms. The cause of the chest pain was found to be esophageal in origin in 54%, consisting of regurgitant esophagitis, cardiospasm, esophageal neoplasm, diverticulum, and stricture. The etiology was due to incompetency of the esophagogastric junction.

Sealy and his associates [112] emphasized the usefulness of esophagoscopy in evaluating patients with reflux esophagitis. When a patient has a hiatus hernia with bizarre complaints, the demonstration of inflamed and eroded mucosa esophagoscopically explains these symptoms.

Sullivan and his co-workers [113] described the occurrence of esophageal ulcer in very young infants. A case was reported of fatal gastrointestinal hemorrhage from a small linear esophageal ulcer just above the gastric cardia of a newborn premature infant. Asphyxia and probably intracranial trauma were thought to have been important factors in the production of the ulceration. Another case of reflux esophagitis, occurring in a 4-week-old infant with a sliding type of hiatus hernia, was presented. Complete obstruction of the esophagus occurred, and this was thought to have been the result of inflammatory edema and stricture. The obstruction was relieved three weeks after gastrostomy was performed.

Hoag and his associates [114] studied the effect of surgical intervention with the esophagogastric junction in dogs and found that esophageal ulceration or esophagitis was a constant finding. It was concluded that a sphincter must exist at the level of the esophagogastric junction and that this sphincter was the most important and possibly the only mechanism for the prevention of gastric-juice reflux into the esophagus, with its resulting complications.

ESOPHAGEAL STRICTURE

In the management of benign strictures of the esophagus, Holinger and his associates [115] agreed that before surgical treatment dilatation of the esophageal stricture should be continued until one is satisfied that a functional esophagus can not be obtained by these conservative measures. Dilatation of benign strictures of the esophagus was performed in several ways, depending on the location, size, and rigidity of the stricture. The most rapid and safest method of dilating tight, fibrous strictures was found to be gastrostomy and peroral Plummer bouginage over a string held taut at the gastrostomy opening. The most satisfactory method of dilating an early, less fibrous stricture proved to be by graduated mercury-filled rubber bougies. In this series there were 43 cases of congenital strictures, 38 of whom responded to dilatation and 4 were operated upon. Postoperatively three of the four who had a gastroesophageal anastomosis required endoscopic dilatation postoperatively similar to that used preceding operation. There were 169 patients with burns and strictures of the esophagus and most of these responded to dilatation, although 27 had complete atresia, necessitating biplane fluoroscopic guidance to recan-

nulate the lumen. In two cases treated surgically by skin tubes, one was successful and one was not. In two retrosternal esophagojejunal anastomosis gave complete relief of dysphagia, while three intrathoracic gastroesophageal anastomoses were performed but endoscopic dilatation became necessary because of formation of severe stricture at the site of the anastomosis. In the management of acute burns, the use of antibiotics and early bouginage by mercury-filled bougies together with corticotropin (ACTH) and cortisone to relieve early pain and dysphagia was advocated. In six patients operated on for strictures of the gastroesophageal junction associated with hiatal hernia, recurrence of the stricture at the point of anastomosis formed, necessitating the resumption of peroral dilatation. In 236 cases of cardiospasm 75% responded to an occasional pneumatic bag or mercury bougie dilatation, while of the patients operated upon, 7 required resumption of dilatation after surgery, 5 having had resection of the cardia and gastroesophageal anastomosis and 2 the Heller operation. Ninety-six patients were presented with benign postsurgical strictures of the esophagus. Twenty-six were infants or children who had stenosis following repair of congenital esophageal atresia and tracheoesophageal fistula. Eighteen patients had developed stenoses at the site of anastomosis following resection of a benign stricture. Nine patients had esophageal stenosis following surgery for nonstenosing esophageal lesions. In 28 patients benign stenosis developed at the anastomosis after resection for carcinoma of the esophagus or stomach. In 15, stenosis of the cervical esophagus following laryngectomy and partial pharyngectomy or following skin-tube procedures designed to replace the esophagus after resection for carcinoma of the cervical region developed, so that subsequent dilatation had to be employed.

Cody [116] favored retention of the damaged esophagus after esophageal burns if this was at all possible. A major problem of the initial surgical procedure is prevention of further stricture formation at the site of anastomosis. When chemical burns of the mouth and pharynx were present esophagoscopy was carefully done about the fourth day after the burn to determine if the esophagus was involved, and if so mercury bouginage was begun. Those cases that did not respond well to dilatation received the benefits of surgical excision. However, it was felt that if the continuity of the esophagus could be established and maintained this held an advantage over any type of surgical correction. Surgery was resorted to when conservative methods were not beneficial, but conscientious dilatation was successful in most instances.

Barr and his co-workers [117] used permanent sound therapy in eight cases of inveterate cicatricial strictures following recent corrosive lesions of the esophagus. A stomach tube was passed through the nose and left in situ for 10 to 14 days, after which the tube was changed and another tube inserted. Because of the development of secondary cicatricial stenosis the indwelling tube therapy was used for approximately four months. This form of treatment was used in eight cases, and in five at least one year had passed since the termination of the treatment and in the majority the final results were good. In two cases esophagitis occurred as a complication, but this did not prove to be serious. The effect of the treatment was described as being probably due to permanent stretching of the stricture, and it was expected that the results would be better in patients with less severe lesions and less connective-tissue formation.

A case of esophageal stricture in a 3½-month-old infant was reported by Hughes and Vinson.[118] The stricture was thought at first to be congenital in origin but proved to be inflammatory. The stricture consisted of an irregular, inflammatory lesion in the lower portion of the esophagus approximately 1 in. long and located about 5½ in. from the upper alveolar margin.

Gabriel [119] reported a case of esophageal burn from swallowing boiling tea in which

cortisone was used in treatment. It was thought that possibly the child's airway and upper esophagus would have returned to normal with no treatment other than tracheotomy, but the impression was that cortisone hastened the healing and probably inhibited fibrosis with its resultant stenosis.

A case of second-degree burn of the esophagus which was treated by cortisone, penicillin, and an indwelling polyethylene feeding tube and which healed without stricture was reported by Judge.[120]

DIVERTICULUM OF THORACIC ESOPHAGUS

Shaw [121] discussed the nature and treatment of true diverticula of the esophageal wall. The diagnosis was made by radioscopy and esophagoscopy. The objects of esophagoscopy are (1) to find the mouth of the pouch and evacuate its contents, (2) to examine the interior of the pouch and exclude the presence of malignant disease, (3) to take smears and biopsy material from any suspicion-arousing area, and (4) to examine and explore the esophagus in its whole length and to establish the nature of any associated pathology. The true thoracic esophageal diverticula were considered to be the traction type of the middle or lower third of the esophagus, the epiphrenic pouch, and the diverticula at the lower end of the esophagus frequently associated with cardiospasm.

Johansson and Michas [122] reported 17 cases of esophageal diverticulum and advocated surgical removal.

LOWER ESOPHAGEAL LESIONS

Problems of the lower esophagus were presented on the basis of anatomical changes of the esophagus, diaphragm, and cardia by Anderson.[123] In considering the problem of reflux esophagitis alteration of the sphincter action by local lesions was thought to be the responsible factor. It was suggested that diverticula of the esophagus were caused by weakness of the wall from changes in the glands under the muscularis mucosa. Two varied cases with esophagitis secondary to a lesion proximal to the lower esophagus in which there was no interruption of the vagus or phrenic nerve were reported. Since reflux esophagitis occurs when the sphincteric action is insufficient and free hydrochloric acid regurgitates into the esophagus, the sphincter was made incompetent by traction in one patient who had a previous pneumonectomy and by muscular displacement from scleroderma with sclerosis in the other patient.

Baker and his associates [124] reported that postoperative esophageal stenosis was a frequent complication of esophageal surgery and recommended that surgical correction of benign lesions of the esophagus be performed only when conservative measures failed to alleviate the condition. The commonest complication encountered was esophagitis, with ulceration and hemorrhage at the site of the surgical anastomosis. Reflux from gastric secretion was considered to be the cause of the esophagitis, with subsequent stenosis. It was emphasized that surgical procedures of the lower esophagus should preserve the cardioesophageal junction, so that the active physiological valve mechanism could be retained.

SCLERODERMA

Six unselected patients with scleroderma free from the symptom of dysphagia were studied by radiography and esophageal contraction wave tracings by Dornhorst and his associates.[125] The characteristic defect was failure of the propulsive waves to continue normally into the lower half of the esophagus due to weakness and wasting of the muscle of the lower esophagus resulting from scleroderma. From these observations it was considered that esophageal change was commoner in scleroderma than commonly realized.

ESOPHAGEAL HIATUS HERNIA

The problem of hiatus hernia was described as twofold by Lam and Kenny.[126] The internist must advise the patient concerning treatment of a hernia after it has been demonstrated, while the other part of the problem is faced by the surgeon, who in the face of conflicting advice must choose and carry out an operative procedure. The unsatisfactory general status of surgical treatment

of esophageal hiatus hernia appears to be due to lack of standardization of the definitive operation. An anatomically sound repair with closure of the opening by sutures placed posterior to the esophagus appeared to give the best promise of success, and it was recommended that this procedure be used as a standard one in all operations on hiatus hernia.

Eighty-two patients with hiatal hernia were studied both roentgenologically and esophagoscopically by Palmer.[127] The diagnosis was made by repeated roentgenologic examination in 78%, although the first examination demonstrated the defect in only 60%. Of those examined esophagoscopically, the diagnosis was made in 86% and in 80% was made upon the first examination. All the methods of examination proved valuable in demonstrating esophageal and gastric complications of hiatus hernia. The eight patients studied by means of transesophagoscopic biopsy and attachment of metal clips demonstrated that roentgenologic methods were not effective in distinguishing the mucosal pattern of the esophagus from that of the stomach. The gastric mucosa usually extended upward into the normal resting abdominal esophagus, and the mucosa of the esophagogastric junction migrated rhythmically from the level of the diaphragmatic hiatus to the brink of the gastric cavity.

In discussing hiatal hernia, Robb[128] stated that the ampulla at the lower end of the esophagus can simulate a hernia and the most painstaking radiologist may fail to demonstrate a known hernia. Esophagoscopy was used to confirm the presence of a hiatus hernia, to allow biopsy of doubtful tissue, and to afford direct evidence of reflux. It was also used to clear up the source of hematemesis, in determining whether an esophageal ulcer or varicosities were responsible or whether the bleeding was from below the diaphragm arising from the stomach or duodenum.

A study of the fate of esophageal hiatus hernia was made by Sprafka and associates.[129] In a group of patients with small esophageal hiatus hernias 13% progressed to large hernias within five years and 58% of those followed six or more years showed progression to large hernias. Twenty-eight per cent of the patients with large hiatus hernias had serious complications, namely, ulcer, esophagitis, or stricture singly or in a combination in the herniated portion of the stomach.

Holoubek and co-workers[130] reported 50 cases of esophageal hiatal hernia with precordial pain simulating coronary artery disease.

Thomas and his associates[131] reported two cases of esophageal obstruction due to diseased ectopic gastric mucosa. Obstructing lesions of the esophagus should not be classified as malignant without histologic verification, but exploratory surgery is indicated in these cases of obstruction even though the histologic proof is lacking.

ESOPHAGEAL VARICES

In 60 patients with portal cirrhosis and esophageal varices, Palmer and Brick[132] evaluated the severity of the varices by the extent of esophageal involvement and the diameter of the varices in the involved segment of the esophagus. The extent was determined by measuring the portion of the esophagoscope protruding beyond the alveolar ridge when the most proximal varix was encountered. Varix diameter was measured directly under 4-diameter magnification with the transesophagoscopic ruler. Endoscopically the varices exhibited many variabilities, and on repeat examinations the varices had undergone change in 31 patients. Correlation between alterations in varix severity and changes in clinical findings was lacking. The development of varices was observed in seven patients previously free from esophageal varices, and in seven other patients spontaneous disappearance of previous varices was observed. As a result of this esophagoscopic study it was concluded that there was no constant, direct, or reciprocal relationship between varix severity, ascites, and enlargement of the spleen or liver. The state of esophageal varices could not be esti-

mated from the physical findings, and under static conditions the varices were found to appear and disappear.

Using esophagoscopic standards, Palmer and Brick [183] stated that 63% of patients with portal cirrhosis who came under medical surveillance had esophageal varices. Sixty-two patients with various types of primary or secondary liver disease but without portal vein obstruction were studied esophagoscopically using 4-diameter magnification. Varices were found in 4 of 7 patients with chronic heart failure, 8 of 14 with active virus hepatitis, 1 of 2 with hemolytic icterus, 1 of 2 with amebic hepatitis, and 8 of 24 with portal fibrosis. It was concluded that significant varices may develop quickly in response to an increase in portal pressure and may already have developed in certain liver diseases described as precirrhotic.

When bleeding from esophageal varices is severe and hemorrhage massive, Palmer [184] has used transesophagoscopic sclerosis and tamponade to control the bleeding at the time the varices were detected by esophagoscopy. Eight patients were treated, and hemorrhage was satisfactorily controlled through the period before definitive surgery in three cases. The other five patients died several days after the sclerosis before any surgery could be performed. All deaths were due to liver failure. The unexplainable factor was that histologic examination of four of the sclerosed esophagi obtained at autopsy did not reveal any evidence of thrombosis or obliteration of the varix lumen. As a control group 17 patients were treated by immediate pneumatic tamponade as the only local therapy. Eight were controlled, while nine died as a result of hemorrhage, three from exsanguination and six from liver failure. As a result of this experience it was thought that even though effective tamponade may be secured for immediate hemor.hage control the addition of sclerosis injection helps to reduce the amount of blood lost between the period when the tamponade is applied and the definitive surgery is accomplished. Esophagoscopy under telescopic magnification was employed after a Sengstaken tube had been passed into the stomach with inflation of the gastric balloon so that gastric aspiration could be carried out. The gastric balloon was inflated and drawn up against the cardia, and 3 cc. of 5% sodium morrhuate plus the amount necessary to fill the shaft of the needle was injected into the lumen of the varix. This was repeated for three separate varicosities. The esophagoscope was then withdrawn and the esophageal balloon immediately inflated. It was not technically difficult to enter the varix with the needle or ascertain the proper needle position, but the exact location of the injection was, at times, doubtful, and no information was given regarding subsequent sloughing.

Sclerosing therapy for esophageal varices was carried out in a series of 20 cases by Kempe and Koch.[185] Five of the patients died from precipitate hemorrhages during a relatively early stage of treatment, and the fifteen who were still living, in whom the postoperative periods varied from two to ten years, have been free from hemorrhage during recent years. The method employed was first to study the appearance of the varices esophagoscopically in an attempt to determine if they were thin- or thick-walled. In the thick-walled varices sclerosis therapy was not considered advisable because they seldom bled. In the bluish, thin-walled varicosities, sclerosing solution was injected although brisk hemorrhage prevented injection in a few cases. If the case was considered suitable for sclerosing therapy, a single varix was first injected to determine the toleration of the patient for the injection, which in recent years was etholein (ethanolamino-oleate Astra). After an interval of several days the varices were injected by stages, beginning at the proximal level and descending toward the cardia. After all visible varicosities had been injected the patients were examined every four to six months, and if any new varicosities or failure of thrombosis of previously treated varices were seen, these were treated at this time.

The patients selected for sclerosing therapy were first subjected to splenectomy in order to decrease the risk of hemorrhage. In conjunction with the injection of the sclerosing medium there was always minor hemorrhage at the puncture opening, but this was never severe, and hemorrhages were never observed as a serious sequela to sclerosing. The material was divided into two groups. In the first group no varices appeared after the first injection series and the patients remained practically free from hemorrhage. This comprised six cases, and the extent of the varicosities varied. In one only a single varix was present, while in others numerous varicosities were observed and intensive treatment over a one-year period was necessary. The second group consisted of nine cases in which new varices formed after the first injection series and in which the varicosities were very extensive. It was necessary in this group to employ sclerosis over a number of years, and in many cases it had to be continued and was never considered completed. When these cases were examined, new varices could be demonstrated immediately above the cardia and had to receive subsequent injection. The hemorrhages decreased both in frequency and in magnitude. Although the primary approach to esophageal varices should be aimed at complete relief of the condition by means of a surgical operation such as portocaval or splenorenal shunt, when these are not feasible because of some other medical condition or because of the condition of the patient, splenectomy and sclerosis of the esophageal varices should be considered. The sclerosing did not disturb the block in the portal vein or the liver in any way but simply eliminated some of the thin-walled fragile submucosal varicosities. Esophagoscopy with injection was carefully performed and proved to be without danger to the patients and no complications followed.

ESOPHAGEAL ACHALASIA

Taber and Ehrenhaft [136] used three simultaneously recording balloons to study esophageal motility in nine patients with cardiospasm. In four patients after cardioesophageal myotomy the preoperative esophageal paretic recording was altered postoperatively toward a more normal motility pattern, suggesting that the esophageal paresis in cardiospasm is reversible in nature.

Twenty-three patients with achalasia were treated with forced dilatation using a Mosher pneumatic dilator by Berdal and Gulli.[137] In 13 patients the results were excellent, and in 8 patients they were good. No complications were observed. In all of the cases forced dilatation was the primary treatment. Surgical treatment was reserved for the few cases in which dilatation failed.

Disturbance of the normal closing mechanism of the cardia with cardioesophageal relaxation was described as a frequent cause for vomiting in infants by Glaser and his associates.[138] Mild cases of cardioesophageal relaxation can be handled by holding the infants upright after feeding to avoid subsequent vomiting. Roentgen examination with special attention to the cardia is necessary for the diagnosis. In cases of negative roentgen findings, repeated examinations should be done because the closing mechanism may be variable, one time allowing reflux and the next time closing firmly. Early discovery and persistent treatment is needed, since delay may cause esophagitis with ulceration and hemorrhage and possibly later scar formation, with disturbance in motility and elasticity of the esophagus. Three cases of cardioesophageal relaxation originating at birth were reported, and in order to rule out the possibility of regurgitation occurring in normal infants, 33 infants between the ages of 3 days and 8 months without symptoms referable to the gastrointestinal tract were studied fluoroscopically and in none of the infants was any regurgitation observed from the stomach into the esophagus.

Sloper [139] reported seven cases of idiopathic diffuse muscular hypertrophy of the undilated esophagus. All the patients had dysphagia, and the radiologic picture was that of diffuse lower esophageal spasm. In

four instances there was inflammation in the region of Auerbach's plexus throughout the esophagus and in one myonecrosis in the skeletal muscle of the upper esophagus. The etiology of the condition was considered obscure, but there may be some relationship with cardiospasm.

Crichlow and Shaw [140] described abnormal ring contractions of the thoracic esophagus in two cases in which a moderate degree of cardiospasm and marked chronic esophagitis were found endoscopically. In one case immediately below the tracheal bifurcation a stricture was encountered, due apparently to muscle spasm, and although a similar narrowing was noted on roentgen examination of the other case, no stricture was found at endoscopy. The roentgen examination suggested diverticuli, which were not found at esophagoscopy and subsequently disappeared on x-rays, indicating that the finding was due to abnormal peristalsis in the esophagus.

Physiologic studies of the esophageal motility pattern following esophagocardiomyotomy were performed by Nemir and Hawthorne,[141] who found no alteration in the deranged esophageal motility. The beneficial effect of the operation was due to breaking the circus movement at the lower end of the esophagus, thereby relieving a functional obstruction and permitting better emptying. It was thought that a derangement or disorganization of the intrinsic neural mechanism, rather than an absolute absence of the nerve plexuses, was responsible for the disordered motility.

TUMORS OF ESOPHAGUS

A series of 22 muscle-wall tumors of the esophagus was presented by Sweet and associates.[142] Five of the patients who had symptomatic tumors were esophagoscoped, and biopsy specimens were obtained in four. One of these revealed a leiomyoma, two produced no abnormal tissue, and one was incorrectly diagnosed as carcinoma. Endoscopic biopsy of these lesions through an intact mucosa is seldom fruitful, potentially dangerous, and renders subsequent surgical treatment difficult because of contamination. If the esophagoscope can be passed beyond the lesion so that the entire area is viewed and intact mucosa seen, the surgeon can be reasonably sure that the tumor is not a carcinoma. It is not possible by endoscopic means to identify either the various types of benign tumors or noninvasive sarcoma of the muscle wall.

An unusual mixed-type tumor of the midesophagus was reported by Gregg and Stamler.[143] The tumor appeared as a polypoid lesion, and tissue removed at biopsy and by partial resection revealed a complex histologic pattern. It was reported as carcinosarcoma, but the final conclusion was that it probably represented a pleomorphic carcinoma with pluripotential growth propensities.

A case of primary malignant melanoma of the esophagus with metastasis to regional lymph nodes, lungs, liver, pancreas, and peritoneum was reported by Robertson.[144]

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Abstracts from Current Literature

Ear

INNER EAR PATHOLOGY DUE TO MEASLES. J. R. LINDSAY and W. G. HEMENWAY, Ann. Otol. Rhin. & Laryng. **63**:755 (Sept.) 1954.

The commonest complication and the commonest cause of hearing impairment due to measles has been suppurative otitis media. However, at the present time, with appropriate antibiotic therapy, complications due to an associated bacterial infection of the ears and respiratory tract should be a rare occurrence. It is probable that the most frequent type of deafness caused by measles, since the era of antibiotic therapy, has been that due to the direct effect of the virus of measles on the inner ear. This is referred to as a neurolabyrinthitis or an acoustic neuritis.

The authors report on the pathologic changes in the ears of a case of measles illustrating the direct effect of the virus on the sensory structures. The pathologic process may be termed "endolymphatic labyrinthitis" with secondary nerve degeneration.

The lesions affected primarily the stria vascularis. Degeneration of the tectorial membrane and hair cells had occurred throughout. Supporting elements of Corti's organ had disappeared in the lower middle and basal coils accompanied by degeneration of the nerve fibers and ganglion cells, as well as disappearance of the stria vascularis.

In the labyrinth, small proliferating granulomatous lesions were found in the wall of the utricle as well as in the macules of the utricle and saccule and in the cristas with secondary degeneration of the sensory cells.

STEELE, Kansas City, Kan.

DIFFICULTY IN CONDITIONING ELECTRODERMAL RESPONSES TO TONE IN NORMALLY HEARING CHILDREN. ROBERT GOLDSTEIN, JANE T. DANIELS, and SARA B. POLITO-CASTRO, J. Speech & Hearing Disorders **20**:26 (March) 1955.

Eighteen normally hearing children were easy to condition and fourteen were difficult to condition to electrodermal responses to tone according to subjective standards used in a previous study. Ease of conditioning seems to be unrelated to intelligence quotient; to sex; to the ages studied (7 years 6 months to 12 years 8 months); to handedness; to initial, terminal, or maximum resistance; to random fluctuations of resistance; to latency of response; or to overt responses and behavior, except for sleepiness. There may be a slight relationship between the ease of conditioning and the minimum resistance recorded during the test.

PALMER, Wichita [A. M. A. J. DIS. CHILD.].

CLINICAL APPLICATIONS OF RECRUITMENT AND MASKING. FREDERICK HARBERT and JOSEPH A. SATALOFF, Laryngoscope **65**:113 (March) 1955.

If recruitment is present, there are also probably some of the following symptoms: distortion of sound, diplacusis, low threshold of discomfort, very sharp audiometric end-points, and variable hearing. Recruitment occurs in Ménière's disease, labyrinthosis, stimulation deafness, and acoustic trauma. It is absent in conductive lesions, presbycusis, acoustic neuroma, and psychogenic deafness. The loudness balance test of Fowler is useful in determining the presence of recruitment but can only be used if there is a 20 db. or greater difference between the two ears. The difference limen test may prove of value too. The monaural loudness balance test is difficult to interpret, and the Lüscher test is of doubtful value.

For free-field testing of normal ears, the ambient noise level should not be greater than 30 db., but if headphones are used, 50 db. will do. For pathological ears, a higher noise level is permissible. If there is much of a difference in hearing between the ears, masking is necessary. Low tones are more difficult to mask than the high. When sound is carried from one ear to the other by air, there is about 60 db. attenuation; but when carried by bone, probably only a few decibels. An 80 db. masking is about the maximum that can be used without stimulating the tested ear and is also about as loud as the average person can reasonably stand without discomfort. Masking should be used in speech as well as pure-tone audiometry.

HITSCHLER, Philadelphia.

A Series of Cases Treated with Radium for Recurrent Otitis Media and Deafness. A. W. Halphide, Great Ormond St. J., No. 7, p. 22 (June) 1954.

Thirty-three cases of recurrent otitis media and deafness were treated with a single dose of 940 r at the surface of the nasopharyngeal mucosa. Deafness improved in 26 cases (86.5%), and otitis media was improved in 19 cases (63.5%).

McGuigan, Evanston, Ill. [A. M. A. J. Dis. Child.].

The Principles of Plastic Surgery of the Sound-Conducting Apparatus. Fritz Zöllner, J. Laryng. & Otol. **69**:637 (Oct.) 1955.

This paper deals with the preservation and restoration of hearing function following large eardrum perforations and the other destructive processes accompanying suppuration or cholesteatoma of the middle ear. The paper does not concern itself with any specific type of middle-ear or tympanic-membrane deformity, but discusses types of deformities encountered and the results the author has obtained by employing various methods of plastic repair. He stresses that the number of combinations of deformities that result from destructive disease are many and the total number of functional plastic repairs performed as yet are few; therefore, definite statistical conclusions of results are not of value.

His basic discussion deals with free skin grafts in the middle ear and the problems encountered in their successful use from a functional standpoint. He mentions that he relies less on thick grafts, mucous-membrane grafts, and large grafts than he once did; he now finds small thin grafts more successful.

The theoretical basis for the techniques employed is the phase difference created by differential impedance of the sound wave reaching the round and oval windows. Fifty-three available cases were briefly discussed as to results, and included were some reasons for early and late failures. The paper is well illustrated with diagrammatic drawings and audiograms, and a study of these is imperative to a full understanding of the text.

Various techniques, under different circumstances of the drum and ossicular chain, are discussed and illustrated. A very interesting technique described is one in which an air-filled cavity is maintained in a newly formed middle-ear cavity until healing occurs, by packing the cavity with silk thread, the end of which is brought out through the Eustachian tube and nose. This thread is pulled out through the nose after eight days, when there is less danger of adhesions between the graft and the medial wall of the middle-ear cavity. Good success is claimed.

A very helpful illustrated supplementary discussion of this paper is included at the end of the October issue of *Journal of Laryngology and Otology*, under Proceedings of The Royal Society of Medicine, Section on Otology, May 6, 1955. This discussion advanced the opinion that plastic repair of the middle ear for the purpose of functional improvement after destructive disease is a natural step in the evaluation of microsurgery of the ear, and it adds much hope to a large class of hitherto discouraging cases.

LeJeune and Stevenson, New Orleans.

The Use of Controlled Hypotension Combined with the Local Use of Adrenalin as an Aid to the Fenestration Operation. Denis O'Brein and William H. J. Cole, M. J. Australia **1**:300 (Feb. 28) 1955.

The authors describe the method of procedure to eliminate excessive bleeding during the fenestration operation. This is accomplished by the aid of a drug which induces hypotension. They use hexamethonium iodide. The systolic blood pressure is reduced to no lower than 100 mg. of mercury. The anesthetic procedure is as follows: Induction is with Thiopentone and Flaxedil followed by endotracheal nitrous oxide and oxygen anesthetic, supplemented with Pethidine given intravenously. When the anesthesia has become stabilized after induction, the systolic pressure is taken by the oscillation method, 20 mg. of hexamethonium iodide are injected intravenously, and in three minutes the blood pressure is measured. If necessary, additional 10 mg. injections of hexamethonium iodide are given. A reduction to 100 mg. is desired, and this can be accomplished by small doses. This procedure does not interfere with the local use of Adrenalin, should there be additional or uncontrolled bleeding points during the operation. By this method the authors have been able to achieve a minimal amount of hemorrhage during the fenestration operation.

Persky, Philadelphia.

MÉNIÈRE'S DISEASE CURED BY AN INTRATYMPANIC INJECTION OF COCAINE. R. MAYOUX, H. LAFON, and G. LESNE, J. franç. oto-rhino-laryng. **4**:293 (June-July) 1955.

The authors present a case of a 58-year-old man who, in addition to an endarteritis obliterans of both legs and definite coronary disease, developed marked tinnitus and vertigo. One cubic centimeter of 10% cocaine was injected into the middle ear. This was followed by definite disappearance of vertigo, an improvement in the tinnitus, and marked improvement in the hearing. From the authors observation, it seems that by this procedure it is possible to establish that (1) there is a definite permeability of the round window, (2) it is possible to localize the site of the tinnitus, (3) in certain cases it is possible to study the exact functions of the semicircular canal, and (4) there may be a so-called interdependence of the ears.

PERSKY, Philadelphia.

ATTIC PROFUSION IN OSSICULAR SYMPHYSES AND ADHESIONS OF THE MIDDLE EAR WITH A NONPERFORATED TYMPANUM. DAVID CUROTTO COSTA, Rev. laryng. (Bordeaux) **76**:519 (Sept.-Oct.) 1955.

The author discusses middle-ear deafness and its problems. Costa evaluates the pathogenesis of middle-ear pathology. This may be on a postinfectious basis, may be due to allergy, or may be a sequel to sero-otitis. He indicates that both medical and surgical treatment, particularly in the old chronic conditions, have been of negligible value in restoring useful hearing. However, he has had a fair degree of success by a transtympanic instillation of either hyaluronidase or hydrocortisone or both. He outlines his particular technique, which is quite detailed. After establishing the diagnosis that this is either a pure or mixed deafness of transmission, as a sequela of an acute or chronic otitis media or as a result of fibrosis within the middle-ear cavity, he shrinks the nasal mucous membrane and the Eustachian-tube orifice. Then he disinfects the external auditory canal with alcohol and methiolate. He anesthetizes the tympanic membrane with Bonain solution and then places the patient in the dorsal position and inclines the head well backward. He then makes a transtympanic injection of first 0.75 cc. of hydrocortisone; he waits about one-half hour and makes another injection, of 0.75 cc. of hyaluronidase. The site of the injection is sealed with collodion, and the external auditory canal is plugged with cotton. He inflates the Eustachian tube with either a Politzer bag or an Itard's sound. He produces vibratory massage on the mastoid bone, followed by a short ultrasonic application of 1 to 2 minutes to three different sites—first to the mastoid bone, the second from the maxillary condylar region to the opposite mastoid, and the third perpendicular to the insertion of the Eustachian tube—and, finally, a massage of the ossicles by means of a telephone and an increased and decreased intensity for a period of 15 minutes. In conclusion he states that this work is entirely experimental but that he has had a fair degree of success.

PERSKY, Philadelphia.

THE EPIDEMIOLOGICAL SIGNIFICANCE OF DYSENTERY WITH OTITIS. BELA BOLLOBAS, Monatsschr. Kinderh. **103**:293 (June) 1955.

Of 3530 infants and children with bacterial dysentery admitted to a hospital in Budapest, Hungary, 561 patients developed ear complications. Bacteriological examination of the purulent discharge from 135 ears was negative in 53 patients. Dysentery bacilli were never found. In 27 cases cultures yielded Pseudomonas aeruginosa, in 22 cases Proteus, and both organisms in 17 cases. The remainder were Staphylococcus albus, Hemophilus influenzae pneumococci, and nonhemolytic Staphylococcus.

Of 51 patients who had myringotomies because of otitis media, 38 stopped vomiting following the procedure. Of 32 patients who had mastoidectomies, all ceased vomiting after surgery. In 21% dysentery was thought to be connected with otogenic factors. Fever late in the course of dysentery was found to be related to ear complications. In severe cases dysentery cleared following otologic procedures.

Otitis media as a complication of dysentery was considered important from an epidemiological point of view, as it had an unfavorable influence on the course of the dysentery, increased the number of hospital days, and, therefore, caused a rise in the source of infection. Isolation of patients with otitis from other dysentery cases should be considered.

HARTENSTEIN, Syracuse, N. Y. [A. M. A. J. DIS. CHILD.].

Pharynx

TONSILS AND THE HEART. J. FERRE, Acta oto-rino-laring. ibero-am. (Barcelona) **6**:100, 1955.

The author discusses the interrelationship of tonsils with cardiac pathology. He believes that there is an infectious, allergic relationship between cryptic tonsillitis and rheumatic endocarditis. This is probably due to a marked predisposition in the anatomic structure of the tonsils and, secondarily, the marked influence of a streptococcic-staphylococcic infection. During the acute attacks intensive antibiotic therapy is indicated plus, at times, small blood transfusions. On the other hand, during the period of comparative regression of the acute phases, tonsillectomy plus autogenous vaccine therapy is the treatment of choice.

PERSKY, Philadelphia.

Larynx

ANTIHISTAMINIC TREATMENT OF THE ACUTE LARYNGEAL DISTURBANCE IN CHILDHOOD. RAFAEL DE LA PORTILLA, Rev. cubana pediat. **26**:599 (Sept.) 1954.

With the antihistaminic drug the obstructive symptoms of the acute laryngitis promptly disappear, continuing sometimes as a slight case of bronchitis. Bronchopneumonic complications are avoided and the time of hospital attention is reduced sometimes to a brief period of 24 hours. Finally, surgical procedures are avoided, which may be one of the main benefits derived from this therapy.

FROM THE AUTHOR'S SUMMARY [A. M. A. J. DIS. CHILD.].

BRONCHOSCOPY IN PULMONARY TUBERCULOSIS. JOSEPH RAKOWER and MOSHE FEINMESSER, Oto-laryng. israel., No. 4-5, p. 35, 1954-1955.

The authors discuss the role of bronchoscopy in active tuberculosis, and they compare the results as found in the preantibiotic era with present-day results. In 108 tuberculous patients they found pathologic findings in 60%. However, these were, with the exception of seven patients, of a very mild type. Of the pathology in these seven patients, there were such changes as scattered ulcers and fibrotic stenosis of the main bronchus. On the other hand, in 1949 in a group of patients who did not receive the antibiotic drugs, one-half showed frank ulceration and one-third fibrosis of the main bronchus. The pathology in stenosis of the bronchus was principally of an edematous nature. Only two cases showed fibrotic occlusion of the main bronchus. Bronchoscopic findings must always be correlated with clinical, roentgenologic, bronchographic, and pathologic findings. Routine bronchoscopy was not performed in children. However, in a series of 10 cases, he found only 3 cases of fistula and 1 of stenosis. Routine bronchoscopy should be performed in all cases of tuberculosis. Often many unsuspected lesions may be found by this procedure which cannot be demonstrated either clinically or roentgenologically.

PERSKY, Philadelphia.

Nose

TREATMENT OF ORO-ANTRAL FISTULAE. S. W. G. HARGROVE, J. Laryng. & Otol. **69**:709 (Nov.) 1955.

An operation for closure of oroantral fistulae is described, and results in 38 cases thus operated on are cited. A brief review of the anatomy of the antrum in infancy, adulthood, and old age is presented. The clinical picture of acute and chronic oroantral fistula is presented, and the relationship to dental disease and extraction is stressed. A method of treatment of the acute fistula is described in which a polyethylene tube is utilized, in a nasal antral opening in the inferior meatus, per penicillin irrigations.

The three recognized methods of closure of oroantral fistulae are discussed, namely, (1) by making a palatal flap; (2) by making a buccal flap; (3) by freshening the edges of the fistular openings, partially removing some bone, and suturing the edges together.

The operation described in this article is a combination of the three, and it is described for use in patients who do not have teeth on the side operated on. The essential steps described are (1) elevation of palatal and buccal flaps and dissection of the fistulous tract, (2) removal of a sizable area of bone surrounding the fistula, (3) suturing of interdigitating buccal and palatal flaps with tension sutures, (4) application of an acrylic mold or plate to the area, and (5) insertion of a polyethylene tube in a nasal antral opening for the purpose of daily penicillin instillations.

The article is well illustrated by descriptive drawings and by step-by-step photographs showing the operation and the results after healing.

LEJEUNE and STEVENSON, New Orleans.

SURGICAL DIATHERMY IN THE TREATMENT OF NASAL POLYPOSIS. ERIC GUTTERIDGE, M. J. Australia **1**:298 (Feb. 28) 1955.

The author uses bilateral electrocoagulation of the nasal polypi. The nose is thoroughly anesthetized, and the needles of the electrode are inserted into the protruding polyp. A very weak coagulation current is switched on and continued to the point of desiccation. The coagulated polyp is then removed with an alligator forceps. This coagulation then proceeds to the remaining polypi until the entire middle meatus is thoroughly clear. Treatment may be repeated for any residual or recurrent polypi after a fortnight. The author also indicated that removal of the polypi is not necessary, since after desiccation a crust may form and the remaining polyp will disappear spontaneously. There is no hemorrhage at the time of treatment or in the reactionary, or secondary, stage. Furthermore, there is no necessity for an intranasal packing. A mild menthol and paraffin oil is given intranasally.

PERSKY, Philadelphia.

REPARATIVE SURGERY OF THE EXTERNAL NOSE. ERIC GUTTERIDGE, M. J. Australia **2**:408 (Sept. 10) 1955.

The author describes his particular technique in performing the nasal reconstruction of the hump nose. He has developed a technique with the use of special bone-cutting rongeurs for not only the removal of the hump but also the lateral bone work. His postoperative procedure is extremely interesting. He uses the intranasal glove fingers packed with gauze. Externally strips of "ectoplast" are used. He also has a special type of spectacle which may rest on the bridge of the nose and act as a splint.

PERSKY, Philadelphia.

ANTIRETICULOCYTOTOXIC SERUM IN THE TREATMENT OF RHINOPHARYNGITIS IN CHILDREN AND INFANTS. R. MAYOUX, Ann. oto-laryng. (Paris) **72**:528, 1955.

The author uses an antireticulocytotoxic serum which was developed by Bogomoletz to counteract rhinopharyngeal infection. This serum is an animal extract rich in reticuloendothelial tissue. In full doses, its action is to destroy the reticuloendothelial tissue, while in smaller dosage it acts as a stimulant. Its best indication for use is in the recurrent infections of adenoid tissue of the pharynx While the specific mechanism of its action is not definite, it seems to act as a control of infection by the production of suitable phagocytes which will stimulate the production of antibodies. There may also be an antiallergic action. In order to obtain the best results certain prerequisites should be considered. First, the infected and hyperplastic lymphoid tissue should be completely removed by an adenoidectomy, with or without a tonsillectomy. Second, correct any local problems, such as a deviated septum or a sinusitis. Thirdly, an intensive postoperative medical treatment, including the antibiotics locally, vasoconstrictors, and the usual antiseptics, should be carried out.

Usually these children, in spite of the routine outlined above, have recurrences of a rhinopharyngitis every winter, and it is in this type of case where the serum is indicated. The injections are usually started about the first of October. They are given every three days intradermally. Sometimes a local reaction will necessitate decrease in the size of the dose or increase in the interval between doses. The author reports a series of five cases in which there was definite improvement, and he believes that this serum has a definite use in these recurrent attacks of rhinopharyngitis, not only in the prevention of these recurrences but also in the prevention of occurrence of acute rheumatic fever.

PERSKY, Philadelphia.

THE MORPHOLOGY OF THE VIDIAN CANAL AND ITS RELATIONSHIP TO THE PARANASAL SINUSES IN ADULTS AND IN CHILDREN. S. RADOIEVITCH and JOYANOVITCH, Rev. laryng. (Bordeaux) **76**:481 (Sept.-Oct.) 1955.

The authors have studied a series of 700 adult skulls, and they found that in 33% of the cases the vidian canal was in close proximity to the posterior sinuses. In 19% it was found predominantly in the corresponding sphenoid sinuses; in 10% it was found in both sphenoid sinuses. In 1% it was found in the opposite sphenoid sinus, and in 3% it was found in a posterior ethmoidal cell. The wall of the vidian canal may be extremely thin, and in 6% of the cases they found a definite dehiscence. In a review of 200 skulls of children, the vidian canal was usually found in close relation to the paranasal sinuses only after the ages of 10 to 15 years. This is quite understandable, since ultimate pneumatization of these sinuses occurs at this age period.

PERSKY, Philadelphia.

PNEUMATIZATION OF THE EXTERNAL WALL OF THE ORBITAL CAVITY BY THE PARANASAL SINUSES. S. RADOIEVITCH and JOYANOVITCH, Rev. laryng. (Bordeaux) **76**:493 (Sept.-Oct.) 1955.

The authors have studied 600 skulls and evaluated the process of pneumatization of the external wall of the orbital cavity. This may occur as an extension from the maxillary, frontal, ethmoid, or the sphenoid sinus; in fact, more than one sinus may be involved in this process. These findings are particularly significant from the clinical standpoint in that infections of the sinuses, particularly the sphenoid, may lead to pathologic effects in the sphenoidal clefts and the various structures contained therein.

PERSKY, Philadelphia.

TREATMENT OF THE COMMON COLD AND ITS NASOSINAL COMPLICATION. J. M. FERRANDO BETET, Acta oto-rino-laring. ibero-am. (Barcelona) **6**:123, 1955.

The author believes that the causative factor of the common cold is essentially a virus which is different from that found in the common grippe or bronchopneumonia. He states that the attempt to control this infection by the use of antihistaminics either with or without vitamin C and the antibiotics has not been very successful. He believes that the most suitable medicament is the intranasal medication of a neutral isotonic solution, soluble in water, plus some of the antibiotics, such as penicillin, streptomycin sulfate, and sulfacetamide sodium. Instillation into the nose should be made with the patient's head well back, and the author recommends either the Proetz or the DeLima method of sinus irrigation.

PERSKY, Philadelphia.

ATRESIA OF THE CHOANA—THE OPERATION OF RUDY. MARIO RIUS, An. oto-rino-laring. Uruguay **25**:23, 1955.

The author presents three cases of atresia of the choana, two were bilateral and one unilateral. He followed the technique of Rudy, using the anesthesia described by Rudy and some minor procedural modifications of his own. He was able to effect a complete cure in these cases.

PERSKY, Philadelphia.

CHRONIC MAXILLARY SINUSITIS IN CHILDREN. R. MASPETIOL, Oto-laryng. israel., No. 4-5, p. 7, 1954-1955.

Maspetiol discusses the importance of chronic sinusitis in children. In a series of 202 radiograms, he found 144 opacities of either one or both maxillary sinuses without any frank involvement of the ethmoids, 12 involved both the ethmoids and maxillary sinuses, and 6 showed involvement of the ethmoids only. It was not possible to perform an antral puncture on all of the 144 opaque maxillary sinuses. In the 41 sinuses that were punctured, 28 showed frank pus. According to his experiences, the author feels that in children a chronic maxillary sinus infection is found more frequently than a chronic ethmoid infection. The clinical findings are mucoid or mucopurulent rhinorrhea, cough (particularly at night), nasal obstruction, otitic discharge, headaches, postnasal discharge, and recurrent bronchitis. These may occur either before or after removal of either the tonsils or lymphoid tissue in the nasopharynx. In addition to the routine procedures for establishing a clear-cut diagnosis, such as anterior and posterior rhinoscopy, transillumination, and roentgenograms, the antral puncture definitely is most important.

The author, after evaluating the various methods of treatment, recommends antral puncture with the instillation of 60 mg. of hydrocortisone. He used his technique in 19 cases, in 14 of which he obtained excellent immediate results. While there was an occasional recurrence several months later in a few of these cases, generally speaking, there was marked improvement noted throughout. Five cases did not respond to this treatment. In addition, he suggests that where there have been failures with the use of hydrocortisone recourse must be taken to the displacement treatment of Proetz, repeated maxillary lavages, and, finally, a radical Caldwell-Luc procedure. The latter, however, should be used as a last resort.

PERSKY, Philadelphia.

Miscellaneous

CONGENITAL ATRESIA OF THE ESOPHAGUS WITH TRACHEO-ESOPHAGEAL FISTULA: TREATMENT OF SURGICAL COMPLICATIONS. ROBERT R. SHAW, DONALD L. PAULSON, and ELDON K. SIEBEL, Ann. Surg. **142**:204 (Aug.) 1955.

The commonest congenital anomaly of the esophagus consists of an atresia associated with tracheoesophageal fistula.

Surgical correction of congenital atresia of the esophagus with tracheoesophageal fistula results in salvage of the majority of infants born with this anomaly. Complications encountered in the surgical management of this anomaly are still numerous. The early complications are respiratory in nature and are inherent in the threat to the respiratory tract from (1) the regurgitation of gastrointestinal secretions into the tracheobronchial tree through the fistulous opening between the lower segment and trachea and (2) the aspiration of mucus and saliva from the blind upper pouch into the larynx and trachea. The late complications of stricture and recurrence of tracheoesophageal fistula arise from problems concerned with the anastomosing of the two ends of the esophagus. Associated congenital anomalies are present in approximately 25% of these infants, but the presence of these anomalies may not always make it impossible to restore these infants to a near normal state. The prevention and treatment of the complications encountered in dealing with this anomaly are discussed.

BANTIN, Omaha [A. M. A. J. DIS. CHILD.].

CHOKING ACCIDENTS. LAWRENCE R. BOIES, Minnesota Med. **38**:235 (April) 1955.

Choking accidents in children are common and can be avoided in many cases. Children should be quiet and calm at eating time. Nuts, popcorn, firm pieces of fruit, and fruits containing large seeds should not be fed to children. The play area should be kept free of objects which are likely to be placed in the mouth. In the rural areas grain and shelled corn are added hazards.

STOESSER, Minneapolis [A. M. A. J. DIS. CHILD.].

ACUTE RESPIRATORY INFECTIONS: THE PROBLEM OF CONTROL. CLAYTON G. LOOSLI, New York J. Med. **55**:3079 (Nov. 1) 1955.

Loosli, from the Section of Preventive Medicine, University of Chicago School of Medicine, described his investigations before the 149th Annual Meeting of the Medical Society of the State of New York, May 11th, 1955. He said that upper respiratory tract infections are responsible for 50% of all cases of total disabling illness. He emphasizes, "The majority of respiratory tract infections are nonbacterial in origin." It seems that during a six-year study at the Great Lakes Naval Training Center only about one-half of the febrile respiratory infections could be identified "etiologically"! Fall, winter, and spring are the seasons for the greatest number of these respiratory infections. They are often top-to-bottom conditions, involving sinuses, larynx, trachea, and bronchi. Passage from children to adults is common during the school season. Aging seems to slow down the number of such infections. The spread is by air and by contact, chiefly by air. The author sets up some excellent illustrations which show graphically how sneezes and coughs pollute the air of rooms and are immediately transplanted to all who are present. Prevention: (1) air disinfection and dust suppression, (2) clean surroundings and personal hygiene, (3) preventing physical and emotional distress, (4) special diets, vitamins, and improving resistance of the body to infections, (5) use of chemotherapy, antibiotics, and antihistamines, (6) vaccination. Not much is to be expected from "cold vaccines," but polyvalent influenzae virus A and B vaccine is effective, provided the vaccine matches the strain of virus at hand.

ABSTRACTER'S COMMENT: It is about time that we all differentiate between the words inflammation and infection. One may have inflammation without infection (this is likely to occur as a result of bodily insult), but one does not find infections without inflammation, which is one of the elements of "tumor, rubor, dolor, and color" of Old Medicine. The author's observation concerning "infections, nonbacterial in origin," is baffling. We are now coming nearer and nearer to the concept that "viral diseases" are all due to microscopic or ultramicroscopic particles. We still have not seen "the germ of smallpox," nor of measles, nor chicken pox, nor several others,

but they very probably exist and will be seen eventually. How many, many years was it before we discovered the spirochete of syphilis? And we have just photographed the poliomyelitis agent! Bacteriology and serology both have yet a long way to go, but they are being very actively developed. What is needed in ENT work is that *sterilisans magna* which will kill all enemies which invade the body via the respiratory mucous membranes, without harming normal cells. When that is achieved, a great medical triumph will be at hand.

I. W. VOORHEES, New York.

LUNG BIOPSY AS A DIAGNOSTIC AID. FRANCIS W. O'DONNELL, New York J. Med. **55**:3093 (Nov. 1) 1955.

The author is a surgeon in the Fillmore and Deaconess Hospitals and in the University of Buffalo School of Medicine. In many cases a diagnosis of lung lesions can be made by the old, time-honored methods, but we now have effective aids in bronchoscopy, planography, and bronchography. Laboratory help comes from analysis of body fluids, sputum, and skin tests, but we may lean too much on these latter. With the great advances in thoracic surgery, we can have more and more recourse to open operation, especially if direct tube work and diagnosis from biopsy specimens makes exploration of the chest advisable. The chest may be opened under local anesthesia, producing minor morbidity and low mortality. All rules of good surgical procedure should be observed, and postoperative care should, of course, be most careful. Diagnostic biopsy of lung tissue should never be regarded as a therapeutic measure or as a substitute for massive surgery when this is indicated. Four case reports are set down to support the author's observations.

ABSTRACTER'S COMMENT: Too often these days we use the word "remarkable" when we actually mean noteworthy. To say that "Bronchoscopy is not remarkable" is ambiguous and borders on the ridiculous. No medical writer will like this stricture, but let's be honest with ourselves and as clear as possible in our speech and "composition."

I. W. VOORHEES, New York.

DIAGNOSTIC PROCEDURES IN ALLERGY. MATTHEW WALZER, New York J. Med. **55**:3302 (Nov. 15) 1955.

This article is one of a series concerning the fundamental principles of allergy, sponsored by the New York Allergy Society and under the editorship of Samuel J. Prigal, M.D. The commonly used procedures which are employed in the search for agents which cause atopic allergy are (1) skin tests, (2) ophthalmic tests, (3) nasal tests, (4) environmental tests, and (5) dietary studies. Scratching the skin and applying powdered antigens, waiting for 20 minutes, and then comparing the reading with controls is the commonest procedure. Intracutaneous tests are best made by the experienced technician, since the reactions may be violent, even fatal. Positive reactions may not be absolute for diagnosis, and delayed reactions may be unreliable. But using all of them as a check, one against the other, may be very helpful. Ophthalmic tests (a drop in an eye) may confirm some positive skin tests or show that one cannot use horse serum in a given case. Nasal tests are unreliable because the reactions are not specific and might be due to any irritation other than the one used. Environmental tests are remarkable if the patient is removed from a pollen-holding atmosphere. Relief is so immediate! Dietary studies are tedious and prolonged, based on the principle of trial and error. A gradual elimination of certain foods may show which agents are working adversely, e. g., strawberries, cocoa, etc. This is the second article in the series, which will be followed by other reported studies.

I. W. VOORHEES, New York.

BEDSIDE CONSIDERATIONS OF PITUITARY DISEASE. THOMAS HODGE MCGAVACK, New York J. Med. **55**:3415 (Dec. 1) 1955.

McGavack, from the Department of Medicine, New York Medical College, Flower and Fifth Avenue Hospitals, gives his experiences in the medical treatment of pituitary disorders. He emphasizes that there must be no "therapeutic nililism" in such cases and that response to proper therapy ought to be expected. Severe headache and visual loss are chief symptoms, with bitemporal hemianopsia outstanding. X-ray shows a "ballooning" of the sella with attrition of bone according to direction of pressure of the enlarged gland. The "cavernous sinus syndrome"

consists of ptosis, convergent strabismus, and pupillary dilatation. Venous engorgement causes facial pain, and tic douloureux is common from trigeminal nerve involvement. The author goes on to classify the types he has seen. Therapy relates to hormones of the "target organs," drugs which influence hypothalamic function, irradiation, and surgery. Hormonal therapy is a very special subject and not for elucidation here. As for x-ray, the trend of developments is usually seen within three to four weeks. Radiation sickness is to be expected; therefore, dosage must be adjusted from time to time. If no advance toward relief is in sight, surgery must be considered, but all other measures should be tried first. Rapid loss of vision without let-up calls for rather immediate surgery. Diet is important, but too much restriction of carbohydrates and proteins is inadvisable. Fat intake should be held down to about 40 gm. daily. Estrogen and progesterone are useful in some cases.

I. W. VOORHEES, New York.

ALLERGY IN OTOLARYNGOLOGY. MICHAEL H. BARONE, New York J. Med. **55**:3431 (Dec. 1) 1955.

Barone is affiliated with the Edward J. Meyer Memorial Hospital in Buffalo. This paper is devoted to immunology in allergy. He recommends low dosage, working up cautiously as tolerance increases, but avoiding overdosage. After a thorough work-up establishes the diagnosis, one should study the nasal and bronchial secretions, with emphasis on eosinophiles and neutrophiles. Preseasonal treatment is strongly advised, carried through the pollination period. A serial dilution is used of 0.1 to 0.02 cc. of a dilution ranging from 1:10,000,000 to 1:100,000. Intracutaneous administration is carried out at intervals of two to three days according to response. One must remember the "outside influences" in air and in diet which work against injections or increase the sensitivity. In very small children, one may use a tablet under the tongue, with some good results, avoiding meanwhile all foods known to sensitize the child. Histamines are useful but must be administered with caution and discretion based on experience. Antibiotics are abused when given for "colds," which may not be such at all, but evidence of allergy rather than bacterial infections. However, a vaccine containing Staphylococcus toxoid has proved useful where indicated. The discussant, Dr. S. F. Kelley, of New York, emphasized that antibiotics give the physician a false sense of security when they mask pathology, giving the false impression of improvement in sinus and ear complications. Eventual surgery may surprise the spectator when he sees what insidious effects have been surreptitiously stewing away without objective evidence.

I. W. VOORHEES, New York.

GASTROESOPHAGEAL INCOMPETENCE, PARTIAL INTRATHORACIC STOMACH, AND VOMITING IN INFANCY. FREDERIC N. SILVERMAN, Radiology **64**:664 (May) 1955.

Cardioesophageal relaxation (chalasia), partial thoracic stomach, congenital short esophagus, and gastroesophageal incompetence in general is the theme of a 10-page article. Many doubts are expressed about the accuracy of identification of the cardioesophageal junction by x-ray, and the author concludes that clear differentiation is not always possible and that two conditions may be identical or different stages of the same condition. "Congenital short esophagus" probably does not exist as an entity but represents esophagitis and cicatrical retraction due to regurgitation of acid gastric contents into the esophagus.

To evaluate the incidence of esophageal reflux, 100 hospitalized infants and children were examined in varying positions after the administration of the standard barium meal. Twenty-seven showed evidence of reflux into the esophagus. Eighteen of the remaining seventy-three had clinical disease associated with vomiting. Under 1 year of age, the number of the vomiting group was appreciably greater, over 5 years, markedly decreased. None of the children who showed reflux had radiologic features suggesting hiatus hernia or chalasia. Postural treatment which frees the esophageal orifice of liquid stomach contents is the method of choice.

ANSPACH, Riverside, Ill. [A. M. A. J. DIS. CHILD.].

RESPIRATORY HAZARDS OF OPIATES AND OTHER NARCOTIC ANALGESICS. J. E. ECKENHOFF, M. HELRICH, M. J. D. HEGE, and R. E. JONES, Surg. Gynec. & Obst. **101**:701 (Dec.) 1955.

The authors have accumulated considerable data of interest in the course of investigating effects of anesthetic agents upon the development of respiratory acidosis. They were particularly interested in the effect of commonly employed narcotics upon respiratory rate, minute and tidal volume, and carbon-dioxide alveolar pressure.

The sensitivity of the respiratory center to carbon dioxide is an important protective mechanism of man. Under the influence of sleep, narcosis, or coma it is one means for maintaining normal respiration. Depression of the respiratory center by opiates diminishes the ability of the patient to withstand or overcome respiratory complications.

Elevation in "alveolar" pCO_2, depression in respiratory minute volume, and reduced respiratory response to elevation in "alveolar" pCO_2 have been shown to be invariable accompaniments of opiate administration. Respiratory rate was found to be an unreliable clinical index of respiratory depression by opiates.

The authors urge that opiates be used for the relief of pain specifically and that all precautions be observed to prevent the use of narcotics in situations where respiratory depression might be a problem because of their administration. They question the routine preoperative use of opiates for this and other reasons.

FRIEDBERG, Chicago.

CARCINOMA OF THE HEAD AND NECK: PLEA FOR MORE RADICAL SURGICAL EXCISION AND THE IMMEDIATE EMPLOY OF THE STEPS OF RECONSTRUCTIVE SURGERY. H. CONWAY, Surg. Gynec. & Obst. **101**:766 (Dec.) 1955.

The author points out that the modern trends in cancer surgery call for resection of primary lesions together with regional lymph nodes. He makes the statement that carcinomas of the head and neck, the oral cavity, and the pharynx have not been subjected to the same degree of intensified clinical attack as have carcinomas in other portions of the human body. He thinks this may be due to the fact that specialists of widely different categories are caught in the interplay between regions. He also states that the greatest deterrent to radical surgery as the ideal method of treatment has been the fear of or concern over the mutilating effect of such procedures. If the principles of reconstructive surgery are taken into consideration before radical surgery is employed, the surgeon will excise much wider areas of the head and neck, thus creating background for the reporting of greatly improved follow-up results.

The employment of this principle in the surgery of carcinoma of the oral cavity may require the prior preparation of a tubed pedicle of skin and fat. In cases where information would indicate that the carcinoma is of relatively low-grade malignancy and of slow growth, it is justifiable to delay the radical excision two weeks or so to prepare a pedicle or flap over the acromiopectoral region. The availability of such a flap changes the approach of the surgeon and there need be no hesitancy in the wide excision of skin, subcutaneous tissue, muscles, bones, and mucous membranes adjacent to the lesion.

A plea is made for consideration, in advance of excisional surgery, of the techniques of reconstructive surgery in the management of carcinoma of the oral cavity with the goal of improved follow-up results.

FRIEDBERG, Chicago.

BRONCHIAL COMPLICATIONS OF TUBERCULOSIS IN INFANTS. L. PIETRANTONI and A. VAGO, Ann. oto-laryng. (Paris) **72**:115, 1955.

The authors discuss bronchial complications of tuberculosis in infants and children. These are (1) stenosis of bronchi due to extrinsic glandular compression with or without inflammation of the mucous membrane, (2) stenosis due to extrinsic compression with perforation or ganglio-bronchial fistulization, (3) cicatricial sequelae of these perforations or fistula, (4) broncholithiasis. As a consequence of some of these pathologic conditions secondary pulmonary conditions may arise, such as (5) obstructive emphysema, atelectasis, and pulmonary consolidation; (6) bronchoalveolar aspirations; (7) bronchiectasis and fibroparenchymatous bronchiectatic states.

They evaluate a series of 137 patients, in which there were 19 cases of stenosis, 39 cases of perforation of the fistula, 11 cases of cicatricial stenosis, and 6 with broncholithiasis. In a further breakdown of the cases of fistulization, 4 presented massive fistulae or perforations, 16 a simple fistula, and 19 excessive granulations or proliferation about a small fistulous tract. They stress the fact that bronchoscopy in these infants can be performed without too great difficulty. They use tubes of 3 to 4 mm. in diameter. The search must be made with extreme care, since often these lesions are very small and will escape the casual observation. By their method, they have not had any accidents or complications following their procedures, which were employed in children 2 to 3 years of age. Furthermore, they were able to aspirate the bronchial secretions and follow this with instillation of iodized oil. Bronchograms were made, and the excess oil was

immediately aspirated. Here, too, not only was there an absence of complications following their technique but they were able to obtain valuable diagnostic information as to the extent of the pathology present. They report a series of eight typical cases which illustrate the value of these procedures.

PERSKY, Philadelphia.

THE ROLE OF THE CHORDA TYMPANI IN TASTE. S. TARAB, J. franç. oto-rhino-laryng. **4**:278 (June-July) 1955.

The author reviewed 55 cases which have had either a chronic suppurative otitis media or a radical mastoiditis and found that in those with a lesion of the chorda tympani nerve the loss of homolateral taste of the anterior two-thirds of the tongue is a constant finding. On the other hand, he also found that in most of his patients (90%) there was an associated decrease in the taste sensation of the posterior area of the tongue for sugar, salt, acid, and bitter.

PERSKY, Philadelphia.

ETIOLOGICAL ASPECTS OF DISTURBANCES IN SWALLOWING IN THE NEWBORN PERIOD. M. BERNHEIM, R. FRANCOIS, J. A. ROUX, and C. MOURIQUAND, Pédiatrie **10**:70, 1955.

After describing two cases of pulmonary distress due to aspiration of amniotic fluid and/or milk with recovery, the authors describe a very unusual case of swallowing difficulties caused by a congenitally enlarged thyroid gland, diagnosed only at autopsy.

GLASER, Baltimore [A. M. A. J. DIS. CHILD.].

SYNCOPE AS AN INITIAL MANIFESTATION OF OTITIS IN INFANCY. A. FETOZANO, Acta pediat. españ. **13**:158 (March) 1955.

The author presents clinical histories of six infants whose first symptom of an otitis media was a convulsive seizure or a collapse with signs of shock.

Most of the children were under 3 years of age, and the shock had to be treated before the initiation of sulfonamide and antibiotic treatment.

ALLEN, Santa Fe, N. Mex. [A. M. A. J. DIS. CHILD.].

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FOREIGN AND INTERNATIONAL

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General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Netherlands.

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Place: San Juan, Puerto Rico. Time: April 8-12, 1956.

President of Congress: Dr. Juan H. Font, Medical Arts Building, San Juan.

General Secretary: Dr. C. E. Muñoz MacCormick, P. O. Box 9111, Santurce 29, Puerto Rico.

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* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

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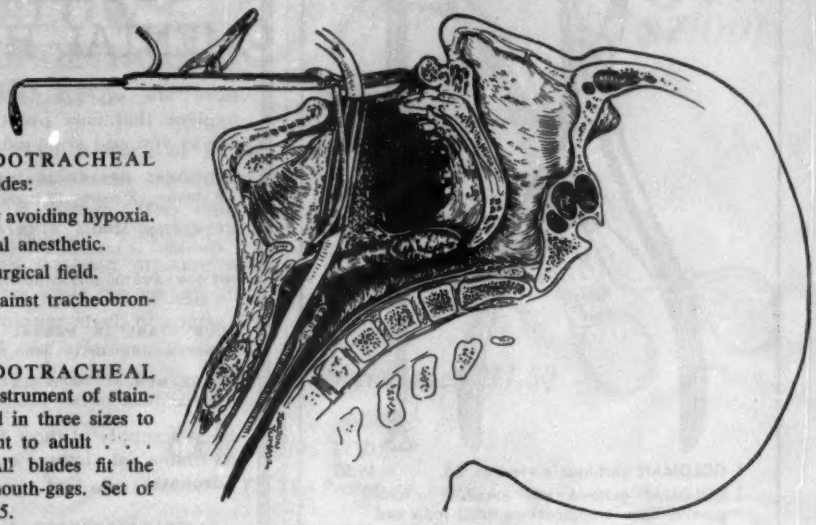

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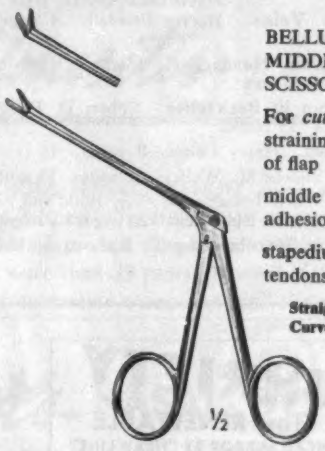

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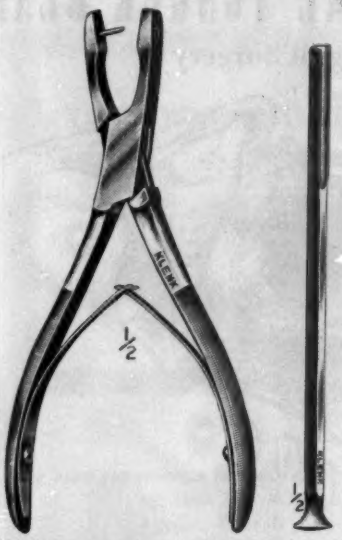

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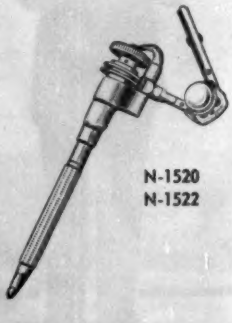

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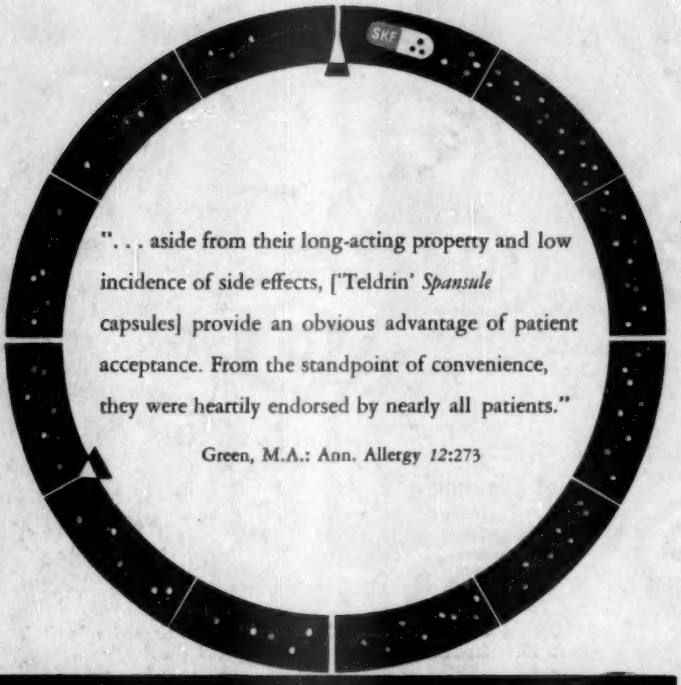
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